Engin

The Engineer

VOL. CLXXXV — FROM JANUARY TO JUNE, 1948

London:

OFFICE FOR PUBLICATION AND ADVERTISEMENTS, 28, ESSEX ST., STRAND, W.C. 2

THE ENGINEER

A Seven-Day Journal

The Ministry of Works

TOWARDS the end of December, the Ministry of Works published, through the Stationery Office, its first report, which covers the period from the end of the war to December 31, 1946. It shows the development of the functions of the Ministry to include the wartime building programme, and the general organisation of the building, civil engineering, and building materials industries. The organisation of the building industry and the work of the various committees and advisory committees is fully discussed. Features of the work have included ways of improving output, achieving a higher standard of welfare work throughout the industry, and the steps taken to deal with the shortage of contractors' plant, particularly excavators. The work done by the mobile repair service is also described. Intensive efforts were made to revive the production of building materials since the end of the war, and assistance was given in this field, in such matters as recruitment of labour, the supply of machinery, spare parts, haulage equipment and fuel. As the production authority for basic building materials, the Ministry was responsible for the distribution of building materials, components and fittings, and ensuring supplies for priority projects. It was also responsible for the price control of most building materials. With regard to housing, 96,000 houses were completed by December, 1946. The Ministry's main concern, however, was in the field of experiment with non-traditional forms of construction. Much was accomplished in the matter of investigation and research, and between January, 1942, and December, 1946, over 2000 non-traditional processes were considered. Work was concentrated upon processes in which mechanical plant was likely to yield the most useful immediate results. New uses were found for existing machines and new machines were developed. Standardisation in building and civil engineering was introduced and extended. In exercising its functions for the preservation of ancient and historic buildings, up to December, 1946, over 6000 ancient buildings in England, Scotland and Wales were scheduled under the Ancient Monuments Acts, in addition to which the Ministry was made responsible for the guardianship of many ancient monuments now in private ownership.

The Status of the Professional Engineer

THE timely subject of the status and registration of professional engineers was discussed at a meeting of the North Wales Society of Engineers, held in Wrexham just before the Christmas holiday. It was remarked in the course of the discussion that the confusion in the public mind between the professional engineer and one who should more properly be described as a mechanic, electrician or fitter, had been exemplified by the recent use by the B.B.C. of "engineer" to describe an automatic machine setter, a fact to which attention was subsequently drawn in the correspondence columns of the *Radio Times*. Whilst the skill required to become a good machine setter or tool maker was not disputed, the meeting felt that more precision in the use of the term "engineer" was undoubtedly desirable. Representatives of the legal, medical and architectural professions attended the meeting and explained how registration affected their particular callings. Emphasis was also given to the advantages which would accrue from the registration of engineers, both from the point of view of the public and the raising of the status of the profession itself. At the conclusion of the discussion, a resolution was carried expressing full agreement upon the desirability of confining the use of the term "engineer" to properly qualified persons.

Retirement of Baron van Haersolte

AT the end of the year Baron van Haersolte, the director of the Nautical and Technical Institute, Rochussenstraat, Rotterdam, retired from a post which he has held with distinction for so many years. He is succeeded by Captain Berg, R.N.N., but will be retained as a consultant. Baron Haersolte was born at Zwolle, in 1877, and he entered the Netherlands Navy in 1893. He was attracted by the technical side and spent some years in the torpedo service. On his retirement in 1905, he joined the signal staff of the Holland Railway Company. In 1912 he was invited to join the Dutch Patent Board and served in the shipbuilding and railway sections, and later as an agricultural expert. During the first world war he was recalled to the Navy and was engaged on mine destruction work. Towards the end of 1918 he became director of the technical institute and museum founded in the Haringvliet, Rotterdam, and for many years he was ably assisted with the library and enquiries side, by Ir. B. E. Cankrien, who also retired during last year. We have described in THE ENGINEER the fine new museum he built during the German occupation and the new collection which has been housed in its walls. Baron Haersolte is an Associate of the Institution of Naval Architects and in 1923 he was awarded the Gold Medal of the Institution. He is also an Associate of the Institute of Marine Engineers, the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders. We wish him many happy years of retirement and good travelling in the many parts of the world he knows and loves so well.

David Jones of the Former Highland Railway

STUDENTS of the locomotive will be interested to hear that in a little ceremony at Inverness recently a portrait was unveiled of the late David Jones, the distinguished locomotive engineer of the former Highland Railway. This portrait has been presented by his daughter and is to hang in the actual room at Inverness where David Jones worked. Jones was appointed Locomotive, Carriage and Wagon Superintendent of the Highland Railway in 1870, and in his twenty-six years of service built some notable engines. The first Highland express engine he built was the "Bruce," of 1874. He also designed the "Skye Bogies" and the 4–4–0 "Lochs," which came out in 1896, and were the last engines built for the Highland to his designs. Two of them still remain in active service. David Jones, however, is best remembered as the pioneer in Great Britain of the 4–6–0 wheel arrangement. Fifteen locomotives of this wheel arrangement designed by Jones were built in 1894 by Sharp Stewart and Co. Known as the "Jones Goods" class, they were the largest and most powerful locomotives of their day and for forty years rendered yeoman service on a variety of duties, including main line passenger work, although they were primarily built for goods working. It was a courageous and farsighted step to introduce so large an engine of untried design, but the excellent performance of the "bogie goods" justified the bold enterprise. But with triumph came tragedy for Mr. Jones, for it was as a result of an accident when stepping down from the footplate of the first engine during her trials that his railway career came to an untimely end. Mr. Jones retired in 1896, and died in London on December 2nd, 1906, in his 73rd year.

A Mechanical Handling Exhibition

WITH the approval of the Government and the support of trade associations, it is proposed to hold, in the National Hall, Olympia, from July 12th to 21st, the first National Mechanical Handling Exhibition and Convention. The exhibits to be shown will include aerial ropeways, conveyors and elevators, conveyor belts, coal, coke and ash handling plants, cranes, gears and chains, hoists, stackers and pulley blocks, lifting gears, hand and power driven trucks, runways, wagon tipplers, pneumatic handling plants and all kinds of accessories. The exhibition has been promoted by the proprietors of our contemporary journal, *Mechanical Handling*, with the support of the Association of Crane Makers, the Foundry Trades' Equipment and Supplies Association, the Hand-Lifting Tackle Makers' Association, the Industrial Truck Manufacturers' Association, Ltd., the Materials Handling Export Group, the Mechanical Handling Engineers' Association, and the Truck and Ladder Manufacturers' Association. Concurrent with the exhibition there will be a convention on "Mechanical Handling in the Production Drive." The papers to be read will be planned to be of practical value to visitors. Dock and harbour loading and unloading systems will be dealt with and the latest methods of handling bulk materials described.

National Advisory Council on Education for Industry and Commerce

THE report of the working party, which was set up last September by Mr. George Tomlinson, the Minister of Education, to report on the establishment of a national council of technology, has been published by the Stationery Office. The report recommends that, as soon as possible, steps should be taken to establish a national council on education for industry and commerce, to advise the Minister on the national policy necessary for the full development of education in this sphere. Among the suggested functions of the council the following are mentioned: planning of new developments, including national colleges; expansion of existing facilities; improvement of accommodation and equipment; development of research in colleges; methods of examination and certificates of studies; provision of scholarships and awards; preparations of reports, and the co-ordination of the work of the regional advisory councils, and the regional academic boards which have already been set up. Contact, it says, should also be maintained with industry and commerce and appropriate professional bodies, while consultations should be arranged with the University Grants Committee and other appropriate bodies on matters relating to education of a university standard. The proposed council, the report states, should be composed of representatives of the local education authorities, universities, institutions, teachers, employers and employees, in each of the ten regions, together with a number of persons nominated by the Minister to ensure a proper balance of the various interests.

The State of the Navy

(By a Naval Correspondent)

No. I

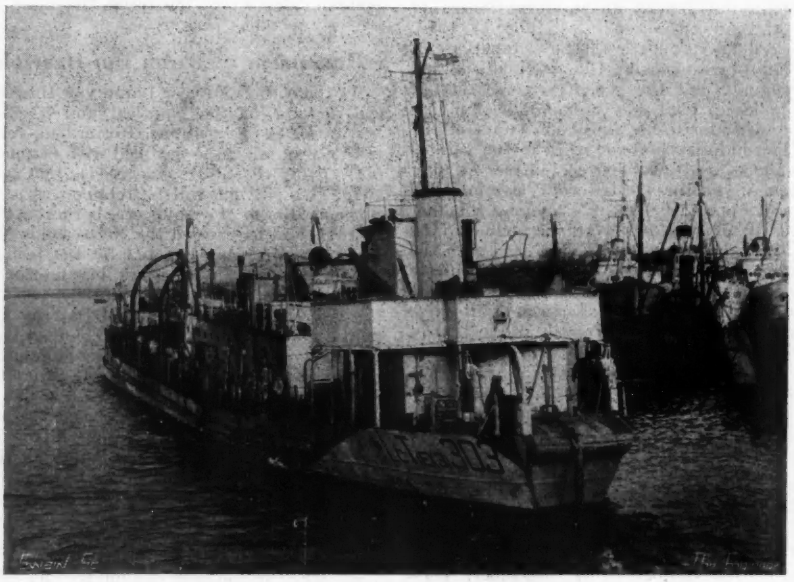
THE Navy, in common with the rest of the country, had a difficult and disappointing year, but, whereas everyone knows, or should know, the problems the country has to face, as they are continually being proclaimed in the Press and over the radio, the problems of the Navy are probably almost unknown outside naval circles. Some concern was shown in Parliament when the second cut in the strength of the Fighting Services was made last autumn, and it was learnt that in order to meet this cut, the Admiralty had found it necessary temporarily to reduce the number of fully operational ships in the Home Fleet to one cruiser and one flotilla of destroyers.

History repeats itself; after every war, the Services are always cut on the score of economy; the cuts this time have been severe, but one cannot help feeling apprehensive when one hears only too frequently that it is intended to make further savings in the next financial year by further reductions in the Service Votes. Anyone who was at the Fleet's Northern Base when the Grand Fleet assembled there in August, 1914, and again in September, 1939, can only hope that, whilst agreeing that the Navy must take its share of austerity now in order to help the country out of its present critical position, the day of reconstruction will not be left as late as it was in the appeasement period between the two wars.

Personnel

Quite recently a statement was made that as the number of officers and men in the Navy to-day is so much higher than it was in 1939, further cuts were justified. Such arithmetical comparisons can be most misleading, as the personnel of the Navy must depend on the numbers and types of ships and establishments necessary to support the foreign policy of the country. Very few who were in close contact with world affairs in the years before Munich will deny that the Navy, both in ships and personnel, was far below the strength required to support a strong foreign policy. Quite apart from the validity or otherwise of the 1939 figure, any comparison with present figures must take account of any changes which have occurred in the period under consideration. In fact, there have been two important changes, the major one being due to the Navy taking over responsibility for its own Air Arm, which now may be considered as one of the major weapons of offence or defence in the naval armoury. The importance attached to the air weapon is such that the personnel employed in this branch of the Navy is now about 25 per cent of that required for what in 1939 would be considered normal naval duties. The second change is that due to scientific and technical advances during the war years. The modern warship is an even more complex box of machinery than its pre-war predecessor and needs a bigger complement; moreover, the personnel required to operate this modern equipment has to be more highly trained. With additional types of ratings and longer periods of training, it must follow that the percentage of men under training to-day is higher than pre-war. It would, therefore, appear to be safe to say that on a true comparison between 1939 and the present day, the manning of the Fleet as a result of the recent cut is, in fact, below the standard of 1939, although the figures of total personnel appear to show the reverse. Further cuts will undoubtedly reduce the Navy to a dangerously low level.

The Board of Admiralty is the only really competent body to assess the number of personnel required to carry out the tasks assigned to the Navy. What are these post-war tasks and how are they being tackled? Apart from the immediate tasks of minesweeping and salvage necessary to make the seas free from danger for the shipping of all nations, the main tasks of 1947 were to reduce the Fleet and its supporting establishments to a peacetime footing and to release the H.O. (hostilities only) personnel in accordance with their age and service groups, as laid down by the Government's policy. On the conclusion of the war, there were large numbers of ships and establishments all over the world, and the first action was to decide on what ships and establishments should be retained either in commission or in reserve, and to dispose of the remainder. This work proceeded satisfactorily during the year; small fleets are now established at Home, in the Mediterranean, East and West Indies, and in the Pacific, and the Reserve Fleet is being put into "cotton wool" (the technical aspect of this work is dealt with later in this article). Redundant establishments are being closed down and surplus ships, craft and stocks of equipment, stores and spare gear have been sold or disposed of in accordance with Government plans. Releases of H.O. personnel proceeded according to plan, but the rate of release is now being accelerated.



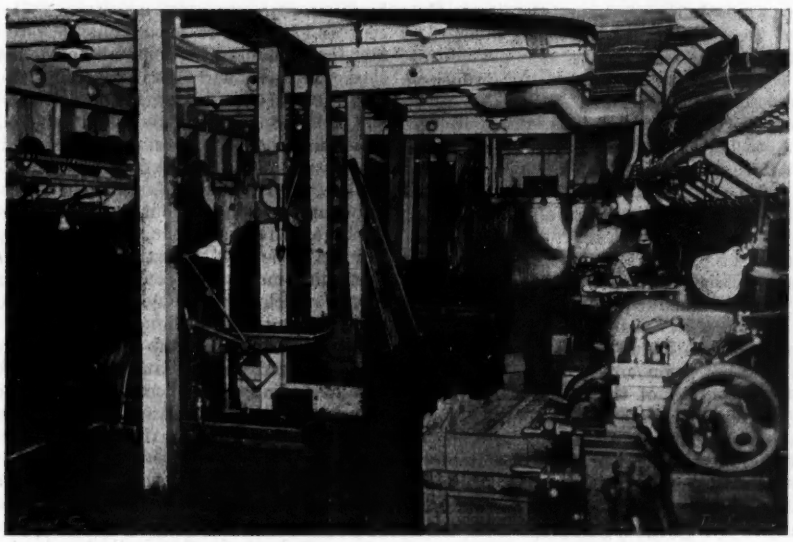
LANDING CRAFT TANK (ENGINEERING)

INTERIOR OF L.C.T.(E.) AS CONVERTED

Recruitment and Training

Having decided on the size of the peacetime fleets and connected details, such as dockyards, bases, &c., necessary for its operation and maintenance, the next stage is to calculate the numbers of officers and

men required and to plan for the entry and training of recruits. During the war the normal flow of recruits ceased, and in consequence, with the release of the H.O. ratings, there is an acute shortage in the lower rates. New recruits are coming in well, but it takes time to train these men for the higher rates, and it will be many years before they are available in sufficient numbers to replace the older men who will be leaving the Navy on pension or on completion of their original engagements. The position is difficult



INTERIOR OF L.C.T.(E). AS CONVERTED

enough now, but may even be worse before a true balance is re-established, as the shortage which at present exists in the lower rates will be transferred to the higher rates.

These conditions put a heavy burden of responsibility on ships' officers and senior ratings, and their anxieties will continue for some years to come as the complements of ships will be continually changing due to the release of H.O. ratings and their replacement by newly trained active service ratings.

Complaints have often been made at the slowness at which releases are made. This is, however, not so simple an operation and cannot be undertaken just by a stroke of the pen. A ship's complement is made up of many different types of men, with specialist knowledge and experience, and each has his part to play in the running of the ship. Naturally, some hold more responsible positions than others, and the removal of one of these key ratings would be a serious matter to the efficient running of the ship. It is therefore not, in general, possible to remove a man without providing a relief to take his place, and this entails a great deal of work for the naval drafting officers, who have to collect a number of men as reliefs for those due for release, and arrange for transport both for the outgoing and returning men. In the early days the transport problem was a very big one, as the greater proportion of the fleet was in the Far East and the Admiralty had to use some of our larger aircraft carriers for trooping duties in order to get so many men home by their release dates.

The training of new recruits is therefore one of the Navy's most urgent problems. Whilst initial training can be carried out ashore, experience has proved the necessity of the final training being carried out afloat. Normally this was done in seagoing ships, but with so few ships in full commission it is no longer possible. The importance the Admiralty attach to this is shown by the formation of a training squadron in home waters, consisting of a number of large ships. The complement of these ships has been cut to a minimum in order to enable the maximum number of trainees to be accommodated; unfortunately, this restricts the normal operation of these ships, and most of the training has to be carried out in harbour, although short trips to sea are included in the training programme. The need for training naval air pilots in deck landing and naval air work generally has been recognised by the retention of an aircraft carrier for this purpose.

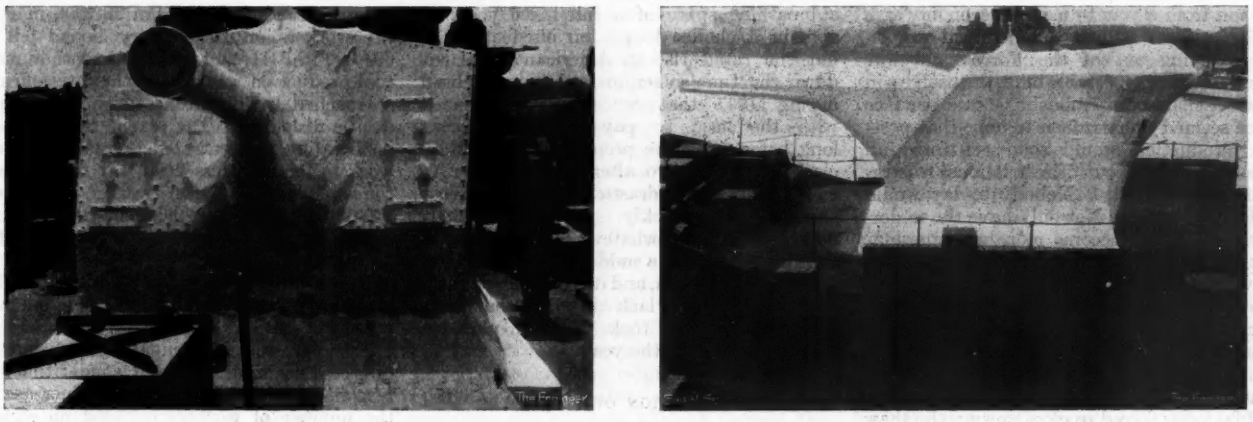
The training of entries under the new National Service Act will necessitate changes in the naval training organisation, and it is understood that this problem is now under active consideration at the Admiralty.

The importance of maintaining adequate reserves in peacetime is fully appreciated, and the Admiralty has decided during the year to reinstitute the Royal Naval Reserve and the Royal Naval Volunteer Reserve, whose officers and men did such splendid work during the war; in addition, it was decided to set up two new organisations, the Royal Marine Volunteer Reserve and the Royal Naval Volunteer Special Reserve. It is also pleasing to learn that the Women's Royal Naval Service is being retained in the peacetime Navy.

On the technical side, training is of the greatest importance, both ashore and afloat. Fortunately, the training of artificers has continued throughout the war, and it has only been necessary to reorganise and modernise the courses to meet present-day requirements; a new establishment has, however, been necessary to meet the need for air artificers. With the growth of electrical equipment in ships the Admiralty decided to set up a separate electrical branch and this was established. The greater use of internal combustion engines during the war necessitated the employment of personnel trained in their operation and maintenance. Naval training commitments have therefore been expanded over and above those of 1939 by the need of technical ratings for the Air Arm, and in the fields of electronics, radar, &c., and of the internal combustion engine.

MAINTENANCE

Probably next in importance to training is maintenance. In the bigger ships with full complements, maintenance of the ship's structure, machinery and equipment can be carried out by ship's staff, assisted by periodic refits by dockyard staff. With reduced complements the task becomes too great, and deterioration must occur, or a greater share of the work must be undertaken by the dockyards. The smaller ships are, however, quite unable to compete with the work, even with full complements on board, and they are therefore dependent on dockyards, bases or repair ships. It is therefore essential to retain suitable dockyards and bases in all parts of the world where



4·7IN GUN MOUNTING ENCLOSED IN LATEX-HALOTHENE PLASTIC PACKAGING

these small ships are called on to operate, or to provide adequate repair ships for their maintenance. A good example of this need was provided in connection with the destroyers in the Mediterranean Fleet, which were employed on patrol duties to prevent the illegal immigration of Jews into Palestine. Malta, the main base of the Mediterranean Fleet, is some 1000 miles from the coast of Palestine; the naval base at Alexandria is no longer available, and Haifa is mainly a commercial port; it was therefore necessary for the Navy to provide its own maintenance facilities nearer the scene of operations. No suitable repair ships being available, the need was met by the provision of an L.C.T.E. (Landing Craft Tank Engineering), fitted with machine tools, welding equipment, &c. This craft was particularly useful during the war as a maintenance unit for landing craft, due to its ability to accompany the amphibious craft in their operations during the invasions of North Africa and Europe; it is, however, not entirely suitable for the maintenance of destroyers, but its employment enabled these destroyers to remain on the Palestinian coast during their spell of patrol duty.

Maintenance of the ships of the Reserve Fleet is a separate and much bigger problem, and it would perhaps be more appropriate to use the word "preservation." The requirement is for such ships of the peacetime fleet which are not required for seagoing duties, to be placed in reserve and so preserved that they can be brought forward for service in a specific time, this period being decided by the Admiralty. Berths must be found for these ships, and it is customary to group a number of the same type together in order to save boat work and to simplify the task of the personnel detailed for their preservation. The number of men available in the Reserve Fleet is quite inadequate for the normal methods of maintenance to be employed, and it is therefore necessary to devise methods of preservation for the ship's structure, machinery and equipment. The same problem arose after the 1914–1918 war, and the organisation then established has formed the basis of the present organisation; there were, however, many details to be tidied up, as war experience had shown up certain weaknesses in the old procedure. The essence of preservation is the exclusion of moisture from all steel surfaces, a very difficult problem with ships afloat in an open anchorage. Modern methods have been developed and small equipment such as a small gun mounting can be enclosed in an airtight envelope after all steel parts have been covered with a protective coating of grease or paint. For the ship's compartments, particularly those containing machinery or electrical equipment, preservation can best be achieved by a continuous ventilation system, including moisture extraction or absorption units, to maintain the moisture content of the atmosphere in the compartment within prescribed limits. Until such equipment is available, any large reduction in the personnel of the Reserve Fleet is quite impossible if the task of maintenance is to be carried out in an efficient manner.

(To be continued)

Labour in 1947

By GERTRUDE WILLIAMS*

No. I

DURING the past year the labour situation was entirely dominated by the problem of manpower. It was a disappointing year on the whole. At this time a year ago we were able to congratulate ourselves on the smoothness and speed with which the conversion from a war to a peace economy was taking place. Millions of men and women were coming out of the Forces and war industries and re-establishing themselves in their civilian occupations. On the surface there seemed every reason to hope that post-war production would soon get into full swing and lift us out of restrictions, frustrations and austerity. Nobody to-day would feel so optimistic. Not only have the underlying difficulties become more obvious, but, as the year 1947 advanced, the climate struck blow after blow and added the imperative demand for comprehensive and rapid adjustments to an already heavy burden. The meagreness of our coal stocks was laid bare by an exceptionally bitter winter with the consequence that transport was dislocated and factories forced to close down; the thaw brought floods that were equally disastrous in their effects, and then, as if the weather was out to show what it could do if it really let itself go, the brilliant summer raised the drooping spirits of everybody until we realised the price to be paid for it in reduced supplies of milk and potatoes.

But dwarfing every other catastrophe into insignificance was the exhaustion of the dollar loan. The complete concentration on war production for so many years left us with a colossal task of re-equipment and reorganisation if we were to regain our export markets and once more meet the cost of essential purchases of raw materials and food. When the loan was first negotiated we had expected a breathing space of a full three years to give us a chance to get on our feet again, but the rapid rise in American prices cut down the time so seriously that we realised during 1947 that we should be faced with the need to pay for our imports long before we were prepared. We had to choose between two alternatives—either to cut our purchases drastically or to increase exports very quickly. Whichever alternative we tried, or whatever combination of the two, demanded a sudden redistribution of our labour resources, and it is therefore almost entirely due to our lack of dollars that manpower movements took pride of place in importance during the year.

Redistribution of Manpower

A quick switch-over of workers from one group of industries to another is always difficult, but when we realise the particular move that is needed at the moment it is not surprising that it is proving even more difficult than usual. It is not possible to appreciate the obstacles that have to be overcome unless we remind ourselves of the dismal history of our principal export industries in the period between the two world wars. It was not a very bright time for industry as a whole, but throughout the two decades the black spots were always to be found in the export trades. There was no time when the number of unemployed dropped below the million mark and by far the largest proportion of this total was accounted for by the export industries. Coal, textiles and shipbuilding were permanently in the dumps, and when the rising tide of prosperity floated others off the mud they remained stuck. During the decade 1927–1936 (half of which were prosperity years and half bad depression) the average rate of unemployment in coal mining was 24·6 per cent, in shipbuilding 40·8 per cent, in cotton 22·1 per cent and in wool 16·9 per cent, despite the fact that the numbers nominally attached to those industries had fallen very considerably—in the case of coal mining from 1,260,000 to 868,000. Such profound and prolonged depression had two serious effects: first, there was no inducement to overhaul and re-equip concerns that were on the edge of insolvency and the lay-out and equipment of mines and factories remained as survivors from an earlier age, while the more prosperous expanding industries—electrical engineering, motor vehicles and the general consumption trades—were establishing themselves in modern buildings with up-to-date equipment and improved workers' amenities. Secondly and more important, because more difficult to assess and counter, was the psychological effect on the worker. For nearly twenty years men were being pushed and prodded and badgered to leave these industries and get themselves into other occupations. Local authorities were bribed to start development plans which would absorb displaced miners, the Industrial Transference Board offered help with removals, trading estates were established to provide alternative employment for redundant shipbuilding workers and so on. A whole generation grew up in these localities under the shadow of the dole, angry, resentful and frustrated, waiting for the chance to get away to something that held hopes of a brighter future. The war brought the opportunity. Shipbuilding immediately came into its own and workers were soon at a premium, but the case was different with the others. The fall of France and Belgium caused dislocation in coal mining and thousands of miners seized the chance to join the Forces or to transfer to better-paid munitions industries; from 782,000 in 1938 the workers on the colliery books fell to 698,000 in 1941, and by the time that more coal production was needed they were firmly entrenched in jobs from which they could not be dislodged. The textile industry was deliberately concentrated so as to release workers for more essential war production; the number of cotton workers fell from 340,000 in 1939 to 220,000 in 1945, and of wool workers from 207,000 to 130,000 in the same period.

In 1947, therefore, the demand for increased exports required the sudden and quick reversal of forces that had been in operation in certain occupations for a quarter of a century, and it is little wonder that the response was so sluggish. The increase in the number of workers engaged on export manufacture has gone up greatly—60 per cent higher than it was before the war—but the increase is to be found in electrical engineering, vehicle building and machinery manufacture and not in coal and cotton and wool, which, depressed as they were before the war, still accounted for the bulk of our sales abroad. The 1947 volume of coal exports was only 2 per cent of pre-war, of cotton only 41 per cent and of wool 76 per cent. In each case the markets were ready

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and eager to buy; the problem was to get enough workers to produce the goods.

If those industries were able to offer exceptionally high wages the unhappy reputation they earned for themselves between the wars might be forgotten. The recent rise of 15s. a week in the basic wage of coalface workers will, no doubt, have some effect unless the non-essential occupations manage to get a similar increase. But the sellers' market already shows signs of disappearing, and if goods are to be sold in world markets at competitive prices they cannot easily outbid industries with a happier history and a longer list of present amenities.

It is not only the export trades that were labour-hungry in 1947. The dollar gap can be bridged from the import as well as from the export side, and one of the most important determinants in our effort to raise the volume of home-grown food has been the wish to cut down our dollar purchases. At first sight the difficulty here does not seem so great, for the present expansion of agriculture is simply a continuation of wartime policy when lack of transport compelled us to rely primarily on home produce, and the manpower of the industry increased accordingly from 711,000 in 1939 to 891,000 in 1947. But the position is not, in fact, as satisfactory as it seems, for a very considerable proportion of this labour force consists of German prisoners of war (over 100,000 of them in mid-1947), who must shortly be allowed to return home; and unless we can increase the number of ordinary workers the industry must decline in size.

Labour in Essential Industries

There are obviously two lines of attack in trying to increase the labour force of these essential industries: (1) We can try to increase the size of the working population as a whole so that there is a larger margin for these trades; (2) we can try and squeeze workers out of less essential jobs and shepherd them into the work which is more important to national welfare.

Both methods were tried during the year. The size of the working population can be increased by persuading more of those of working age to enter industry, by postponing retirement and by import of workers from abroad. The vast majority of men are already occupied in one way or another of earning a living, and there is little opportunity of adding to their number. True there are many jobs which can be done by elderly workers if they can be persuaded to stay on beyond the pensionable age, but the particular industries in which the manpower shortage is most acute are just the ones in which vigour is especially needed. In mining, iron and steel, and agriculture it is the young, strong man who is needed, and practically all of them are already at work.

As far as women are concerned, the position is somewhat different. Here, again, almost all unmarried women are already "gainfully occupied," but seven-eighths of the married women do not work for pay, and the appeal for a larger number of women workers has had to be addressed, in fact, though not in so many words, to married women. The response in 1947 was not appreciable, and it is unlikely that it can be or even that it is socially desirable that it should be. During the war many young married women remained in employment because their husbands were overseas, and they had not yet set up homes for themselves, and allowances were not so generous as to make additions to them unimportant. Now, on the contrary, most of them are anxious to begin family life; cooking, cleaning and looking after small children keep them fully occupied; their husbands are earning good wages; P.A.Y.E. makes the connection between higher income and higher tax depressingly clear and there seems little point in overworking to get more money when there is nothing pleasant to buy. Even if they were willing to go back to paid work it would still be necessary for somebody to do the home jobs on their behalf, at least so far as the care of the children is concerned, and the experience of the war showed that the labour cost of day nurseries is necessarily so high that it is doubtful if anything at all is gained when young mothers go out to work. There is, however, one group of married women from whom additional workers could certainly be recruited; that is, the women whose children are old enough to take themselves to and from school or who are already out in the world. Even in these days of difficult housekeeping the woman with no young children to care for can generally free a few hours for paid work even though the full working day would be far beyond her power, and employers and workers have been strongly urged to make more use of organised part-time employment. This system has been having a good deal of success in the cotton industry—the one big industry which traditionally employs a large proportion of married women—and in several mills married women who had given up their jobs because their household responsibilities made full time no longer practicable, agreed during 1947 to return for part-time work.

Foreign Labour

The third source that was tapped to add to our labour total was that of foreign workers, but it was not easy to overcome the opposition of the organised workers in any occupation into which it was proposed to introduce them. By agreement with the National Union of Mineworkers, a few thousand Polish ex-soldiers were admitted to the mines, and others went into agriculture. A scheme was organised under which Balt women were brought here to act as domestic staff in hospitals and similar institutions, but this was later merged into a larger scheme of recruitment for a wider range of employments. The Ministry of Labour and National Service set up an organisation in the British zones of Germany and Austria, in order to select men and women from the displaced persons camps for work here. There is, of course, no compulsion exercised. Those who volunteer—they are called European Volunteer Workers—are carefully classified with regard to their industrial capacity and experience and they are accepted only on condition that they are prepared to take employment selected for them in one of the undermanned industries, such as mines, textile mills, laundries, general unskilled manual occupations, and so on. When the selected workers arrive in England they are housed in Holding Hostels until they are placed in employment, when they are moved into private lodgings or industrial hostels. The difficulties of finding accommodation are so great that at present the families of E.V.W. are not allowed to enter the country unless, of course, the other members of the family, such as the wife or older children, are themselves prepared to take jobs, but a pledge was given that steps will be taken as soon as conditions permit to bring them over. By the end of October the number of foreign workers admitted was 27,000, of whom 19,000 were men and 8000 women, in addition to the 2600 Balt women brought over before the commencement of the present scheme, and of this total, 16,900 men and 7300 women had started work. The two industries which absorbed the largest proportions were agriculture, which had taken 11,600, mostly men, and textiles, which had taken 5200, mostly women, but heavy iron and steel, nursing and domestic work had also taken considerable numbers.

How far is this type of recruitment likely to solve our problem? A number of valuable recruits can undoubtedly be obtained in this way, but no such attempt to add to our manpower can provide a permanent solution. It must be remembered that workers are consumers as well as producers, and every extra individual makes further demands on housing, food, clothing, transport, furniture, &c. It would be intolerably cruel to prevent workers' families from joining them fairly soon and as soon as this happens the extra mouths to be fed and bodies to be clothed may fully balance the advantage of having additional workers. At the moment the gain predominates, partly because the dependants are not yet here and partly because it has been made a condition of acceptance that jobs in the more seriously undermanned industries should be taken. But can this restriction of choice be anything but a temporary measure? Without violating all our principles of democracy and justice, can we envisage a future in which one section of the community is permanently restricted in its choice of employment and has less freedom of movement than the remainder? If an E.V.W. decided he wished to change his job after he had been here some time, it is surely most unlikely that we should deport him or penalise him in any way, for to do so would run counter to well-established and dearly cherished principles of equality before the law. On humanitarian grounds there is everything to be said for admitting as large a number of foreign workers as can be absorbed and there is no doubt that their talents and skills will be of general value to the community; but as anything but a temporary expedient in filling the undermanned industries it is unlikely to be the answer to our manpower problems.

Registration for Employment Order

During the last few months of 1947 there was a great deal of talk about the need to rope "spivs and drones" into useful employment; there was much criticism of any attempt to force ordinary hard working people to change their jobs so long as any of the community remain idle or, even worse, make a comfortable living out of all sorts of shady transactions. In order to meet this criticism rather, surely, than in the belief that there was a useful source of manpower to be exploited in this way, the Government issued the Registration for Employment Order, which makes it obligatory on certain classes of worker to register themselves as available for employment, which is essential to national economic welfare. The Order applies to men between 18 and 50 and women between 18 and 40, both inclusive, with the exception of married women living with their husbands and women with children living with them and under their charge. Two methods of registration are contemplated; under one individuals will be called upon to register personally, under the second employers will be called upon to register particulars of their employees. The persons who are likely to be called upon are those without any occupation or who are employed in betting and gambling, football pools and amusement arcades, night

clubs and urban street trading. After registration they will be called for an interview by Ministry of Labour officials and offered a choice of essential jobs and, if necessary, directed to one of them.

As the Order did not come into force until December 8th, it is too soon to see what use will be made of it and whether it will be effective; but on the face of it, it seems unlikely to have more than a faint psychological value. The spiv is, by definition, an adept at getting round regulations, and this one should prove child's play to him. Moreover, it is not simply a matter of catching your spiv and dispatching him to a job; you have to find some useful work within his competence and an employer willing to risk introducing such an influence into his business. It is not improbable that such a large number of officials would be needed to track him down, get him cornered, teach him a job and make sure that he does it that a net loss in effective manpower might be the result. The Order is useful only in allowing the Minister to say that "no stone is being left unturned" and "no avenue unexplored" in utilising all possible sources of labour supply before compelling respectable hard-working people to change their jobs, but it would be very surprising if anything more positive resulted.

Control of Engagement Order

On the whole, then, the total labour supply cannot be materially increased and the problem really resolves itself into getting the most effective distribution of what is available. During the year under review exhortation and propaganda had little effect; indeed, in the coal mining industry, where the preponderance of elderly workers was particularly marked, the monthly intake was not enough to counterbalance the outflow and the total labour force was falling throughout the last few months. During the war, when a gigantic redistribution of our productive capacity was needed, the Government was given comprehensive powers over all types of labour with general consent. No such wholesale interference with the freedom of the individual to choose his own way of living would be accepted at the present time, nor is it necessary. At that time the withdrawal of 5 millions of the younger and more vigorous workers into the Forces necessitated a complete reorganisation of all that were left if the essential jobs were to be done in time. But at the moment the shifting of half a million men and women from less essential to more essential work would be ample to tip the balance in the right direction. It is in order to help bring about this change of emphasis that the Control of Engagement Order came into force on October 6th and is expected to operate until the end of 1948. It covers men between eighteen and fifty and women between eighteen and forty, with the usual exceptions, and forbids the engagement of any such worker except through the Employment Exchange or an approved agency. As long as persons in these age groups remain in their present employment they are free from all control (unless they are employed in the type of work referred to above in the Registration for Employment Order), but as soon as they leave their present job they cannot take another without applying to the Employment Exchange, and at that point their liberty of action will be checked. They will be given a choice of three or four essential jobs within which their choice must be made, and if they have not taken action within a reasonable space of time they will be legally directed into one of them. Unlike the similar wartime labour control, only single men and women without family responsibilities may be asked to work away from their homes and great efforts will be made to render even this unnecessary; and there are wide exceptions which narrow the scope still further. Men and women discharged from the Services are free to select any employment they like and employment in any managerial, professional, administrative and executive capacity is free from restriction.

The general purpose of the Order is, then, to steer the margin of available labour into essential occupations, but as the two biggest classes of "steerable" workers—demobilised men and women and young people—are specifically excluded, the results cannot be either rapid or far-reaching. The reduction of capital expenditure and the severe restrictions on raw materials, machinery and building for non-essential industries should, of course, in theory release a large number of workers; but, in practice, this is not so certain a consequence. It is a fact that during the war redundant labour was not released, because of shortage of supplies, but because of the enforced concentration of certain industries in a smaller number of plants. At present, the extremely high prices ruling in most non-essential types of production leave an ample margin of profits to finance the retention of workers who are unnecessary at the moment, but who would be usefully at hand if restrictions let up. It may be that the most important result of the Order will be its psychological effect. To have to reimpose some form of labour direction more than two years after the end of the war should be enough to shock the country into a realisation of the seriousness of the position and may therefore induce people to make changes without waiting for compulsion.

But there are other ways of expanding production even if no more labour is available; better organisation, better management and better machinery are more economical methods than increasing the number of workers and it has been categorically stated that in certain branches of industry the required 10 per cent increase in output could be brought about solely by a more efficient redeployment of their labour than exists at present. In the long run there is no other way of increasing output and raising standards of living except by more efficient methods of production but such rearrangements take time and the export-import gap faces us here and now, so that more immediate steps have had to be taken to avert disaster, and the short term policy has concentrated on longer hours of work and inducements to the worker to do more in the given time.

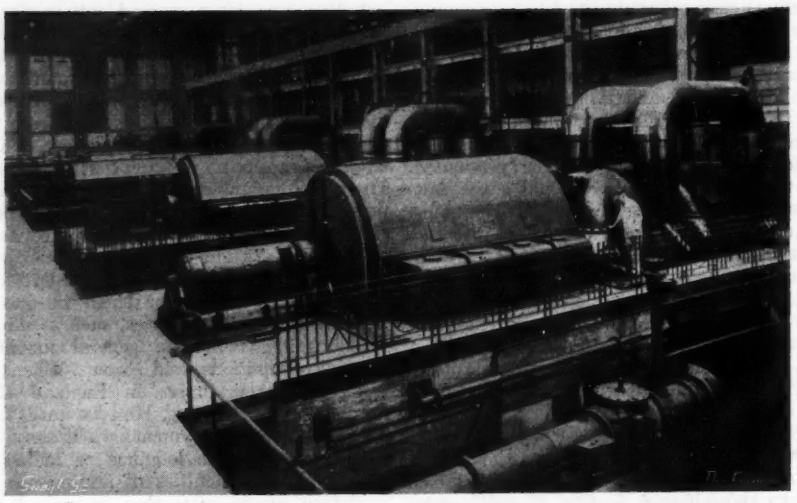
(To be continued)

Electrical Engineering in 1947

No. I

RARELY in the history of electricity supply has the industry as a whole been so much at the mercy of events outside its own direct control as in 1947, when the winter fuel crisis was followed, within a few months, by the Electricity Act, 1947, which prescribes the new *régime* for the ownership and control of the industry. Of the fuel shortage in February and its effects on the country's power stations little need be said here, for the causes and remedy are as well known now as they were at the time. The failure to maintain and replenish coal stocks at the power stations can, as a non-recurrent event, be relegated to history. Not so the Electricity Act, which frames the future of the entire electricity supply industry under State ownership and management.

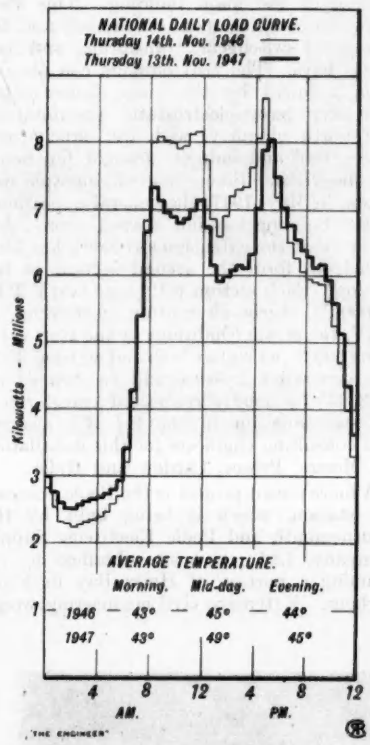
Briefly, the Act provides for the setting-up of a central body known as the British Electricity Authority, with the duty of "developing and maintaining an efficient, co-ordinated and economical system of electricity supply for all parts of Great Britain except the North of Scotland district." For this purpose the main functions of the B.E.A. will be to generate or acquire supplies of electricity and to provide bulk supplies for the fourteen Area Boards which will be established to distribute these supplies to consumers within the areas laid down. These areas, which were generally outlined in a Schedule to the original



30,000-KW TURBO-ALTERNATORS AT KIRKSTALL POWER STATION, LEEDS

Electricity Bill, are to be defined in separate Orders. Towards the end of the year the Minister of Fuel and Power defined the areas by publishing a list of the undertakings falling in each of the fourteen areas, and by displaying at the Ministry maps showing the proposed boundaries.

The first appointment to the B.E.A. was that of the Chairman, Lord Citrine. In August it was announced that Sir Henry Self and Mr. J. Hacking were to be deputy chairmen and at the same time the remaining members of the B.E.A. were appointed. Before the end of the year all but two of the chairmen of the Area Boards were appointed, and of these the four who will serve in rotation as members of the B.E.A. were appointed. It should be mentioned that the Act provides for the establishment of consultative councils of between twenty



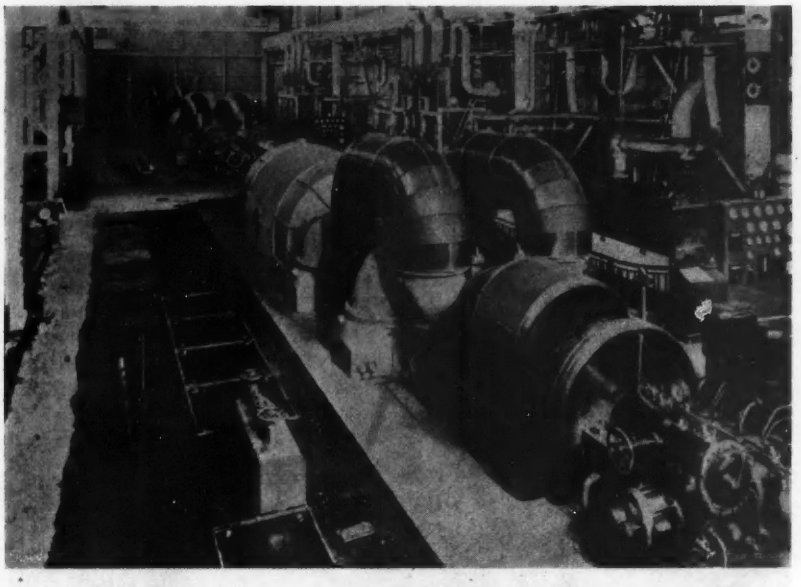
EFFECT OF LOAD SPREADING

and thirty members each, to establish liaison between local interests and each of the Area Boards.

LOAD SPREADING

Of more immediate interest, perhaps, are the efforts made to close the gap between the demand for electricity and the available generating plant capacity. The problem is complicated by various conflicting factors not the least of which is the necessity for reducing capital expenditure, which, as outlined in a recent White Paper, must inevitably affect the production of generating plant.

On the one hand, there is the useful though negative short term remedy of reducing the maximum demand by spreading the load and improving the load factor. A recent announcement by the Ministry of Labour and National Service gave some interesting details of the results already achieved by arrangements made through the Regional Boards for Industry to spread the industrial electrical demand more uniformly throughout the twenty-four hours. The improvement is typified in the diagram, which represents the daily national load curves on two comparable November days in 1946 and 1947. On this evidence it can be inferred that in 1947 the morning peak was reduced by approximately 700,000 kW, and the evening peak by about 600,000 kW, to a figure of just over 8,000,000kW.



40,000KW TURBO-ALTERNATORS, EARLEY POWER STATION, READING

At the same time, the demand during the light load period at night has been increased fairly uniformly by about 300,000kW and the change represents a substantial improvement in load factor.

The more positive method of reducing the gap between demand and supply by increasing supply is one of the principal aims of the Control of Turbo-Alternators (No. 1) Order, which has been in force since November 13, 1947. Despite the apparent paradox in the title, this order should, in the long run, simplify and increase production, for the Order has the effect of standardising turbo-alternators above 10,000kW by limiting their output (in the home market) to two sizes only—30,000kW and 60,000kW, and by specifying the steam conditions for each size. Clearly this limitation should assist manufacturers by reducing the multiplicity of designs required to meet the different specifications of various supply authorities. The resulting increase in production represented by newly completed plant will not, however, be fully realised until about 1950.

By 1950 on the other hand, a new restrictive factor will make itself felt. New generating plant coming into service in 1950 and subsequently will be limited in the aggregate to an annual output of 1,500,000kW, as a result of the Government's decision, contained in the recent White Paper on

CLIFF QUAY POWER STATION, IPSWICH, UNDER CONSTRUCTION

Capital Investment in 1948. The steps taken by the Central Electricity Board to implement this decision were announced recently and details were published in our issue dated December 19th. The first portion of the existing programmes involving the installation of some 6,000,000kW of generating plant, including seventeen new generating stations by the winter of 1950, will not be affected. The remaining programmes for 1951 and 1952, involving a further 3,923,500kW, including fourteen more new stations by the winter of 1952, has, however, been curtailed to comply with the Government's restriction on new output capacity. Revised programmes have therefore been drawn up for 1951 and 1952. A number of the projects originally planned have now been postponed so that the total new plant coming into service in those two years will be 2,287,000kW, which is less than the original figure by 1,636,500kW.

POOLE POWER STATION, SITE AND WORKS, MAY, 1947

NEW GENERATING STATIONS

Turning now to the more material aspects of progress in 1947, we propose to refer very briefly to some of the new items of steam generating plant commissioned during the year and to a few of the power station projects which were in various stages of construction. At the time of going to press the generating plant taken into service by authorised undertakers in 1947 totals 272,500kW. This total includes a 22,500kW Parsons set in the Valley Power Station, Bradford Corporation. In May, the fourth B.T.H. 30,000kW set was commissioned in the Kirkstall Power Station, Leeds. This set appears in the foreground of our illustration, and a fifth machine of the same rating is now being erected. Another illustration shows the three 40,000kW Parsons sets now installed in the Earley Power Station, Reading, of the Central Electricity Board. Other generating sets commissioned in the year under review include a 53,500kW set at Hams Hall, Birmingham; a 30,000kW set at Trafford, and a set of the same output at Ocker Hill. Many of these equipments represent repeat orders and technical interest is perhaps centred upon the growing tendency to standardise upon a smaller number of output sizes with standard steam conditions—a matter which is now the subject of the Statutory Order to which we have already referred.

With the present deficiency in generating plant capacity public interest continues to be focussed on the building of new power stations and the extensions which are being made to existing stations. No apology is necessary therefore for the following brief reference to a few of the current projects, which, when they are completed, will help to meet the evergrowing demand for power.

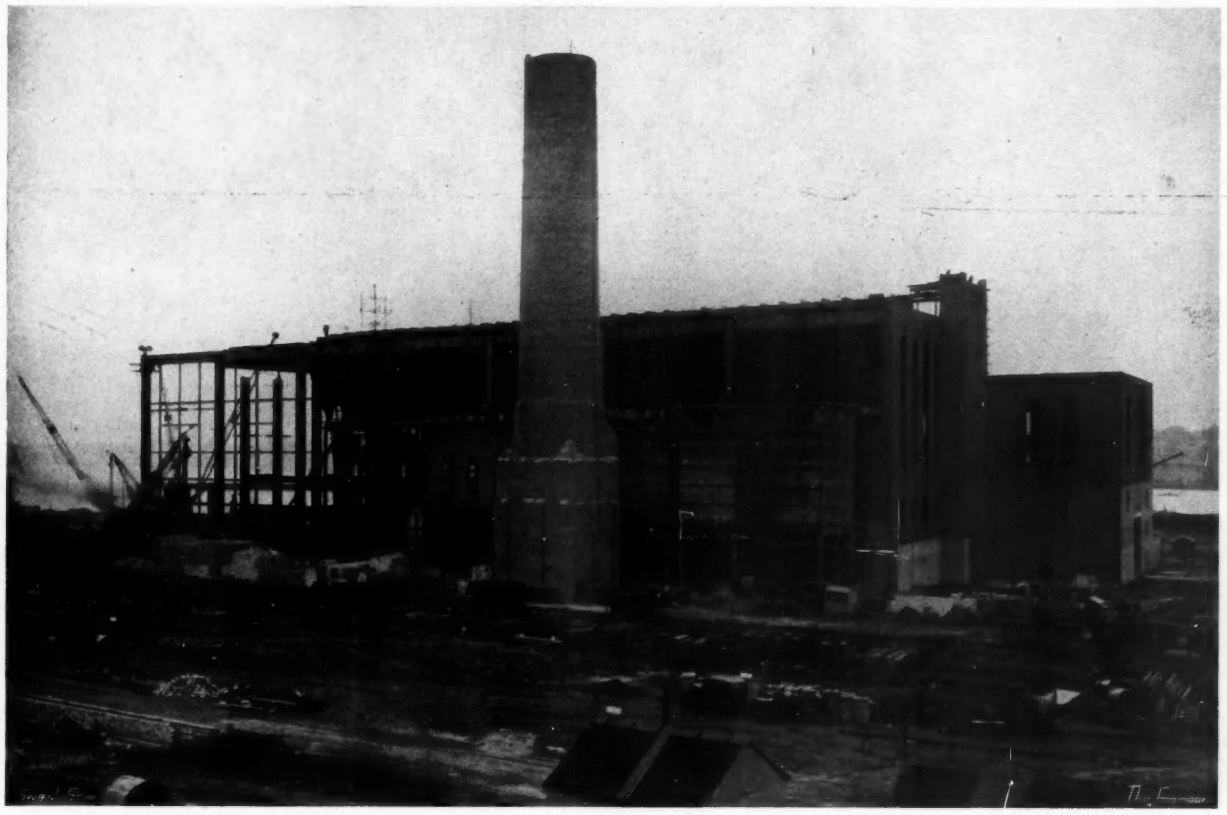
One of the schemes which we have chosen for illustration is the Cliff Quay generating station of Ipswich Corporation. The accompanying Art Supplement contains a general view of this 270,000kW capacity station which will eventually contain six 45,000kVA turbo-alternators and nine Babcock and Wilcox 365,000 lb per hour boilers fired with pulverised fuel, and generating steam at 635 lb per square inch and a total temperature of 850 deg. Fah. Three chimneys will be provided and electrostatic precipitation will be employed. An aerial view of the station and site is reproduced on page 7 to show the steel framed buildings being clothed with brick. In the background can be seen the site for the 132kV substation. The output of the 11·8kV alternators will be stepped up to 132kV before being handled by the 2,500,000kVA rupturing capacity air blast switchgear. An interesting aspect of the layout of this station is that the coal store area has been provided by the reclamation of seventeen acres of mud flat on the bank of the river Orwell, using a double sheet steel pile enclosure, as shown in the aerial view. Outside this enclosure a jetty is being built for the reception of colliers and the circulating water pump-house. A similar reclamation is being made down stream of the coal store to form an ash disposal area.

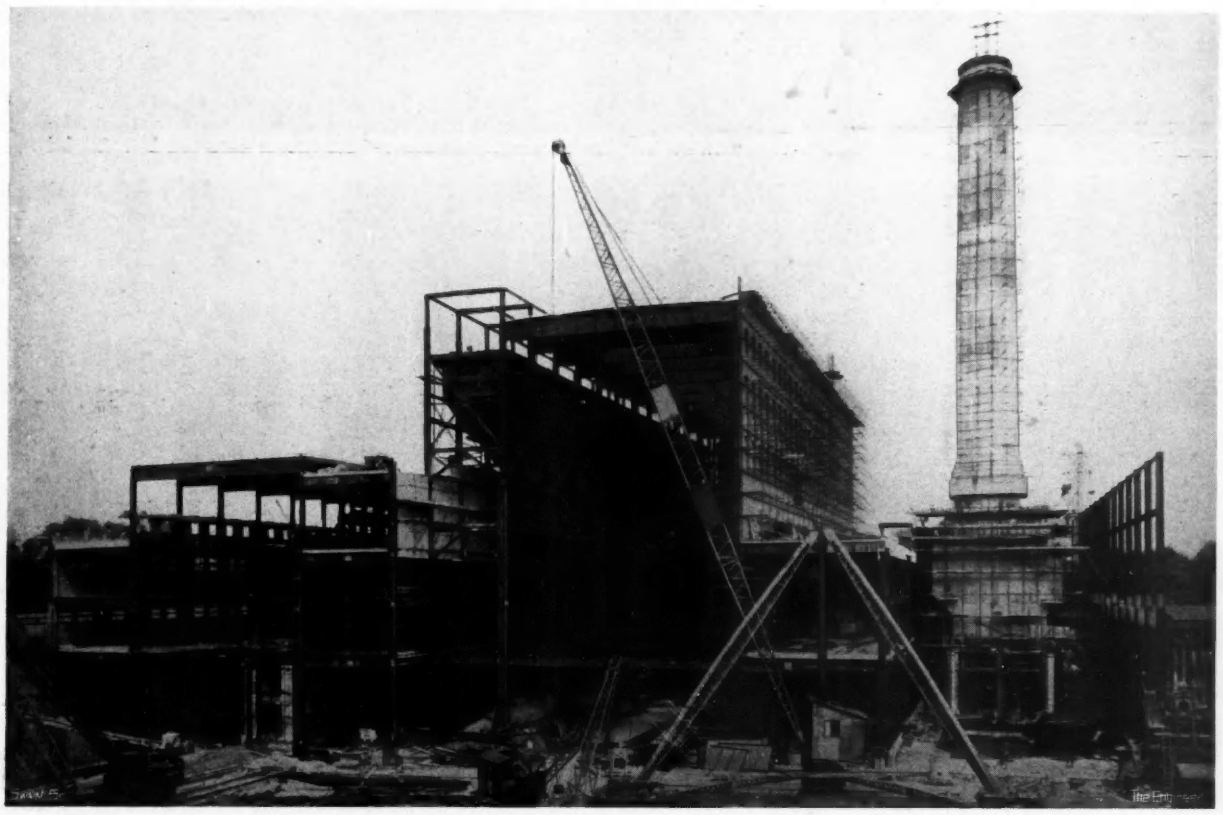
The second illustration in our Supplement gives a general view of the new Kingston power station, conveying some impression of the progress made with the first section of the main building. This view shows the turbine room on the left and the associated switchgear, transformer and feed pump bays. The coal bunkers can also be seen, followed by the main boiler-house, preheater bay, electrostatic precipitators, and north chimney, with the precipitator screen wall and induced draught fan house on the right. Since this photograph was taken, in May, 1947, the general appearance of the building has not altered appreciably except that the extension steelwork has been added, to form the second section of the station. Each section will house two B.T.H. 30,000kW turbo-alternators generating at 11kV, the steam conditions at the stop valve being 600 lb per square inch and 800 deg. Fah. The generated pressure will be stepped up to 33kV by solidly connected transformers for switching on to the C.E.B.'s system. The consulting engineers for this installation are Messrs. Preece, Cardew and Rider.

A more recent project is the Poole generating station, which is being built by the Bournemouth and Poole Electricity Supply Company, Ltd., on a site obtained by reclaiming a portion of Holes Bay in Poole harbour. Extensive civil engineering works were involved in the reclamation and the upper view on this page (from a photograph taken in May, 1947) shows, in the background, a portion of the chalk filling which was used in the preliminary operation of sealing off the site. This illustration gives a broad impression of the main building site, showing the sheet steel piling bounding

POOLE POWER STATION, LAYING CIRCULATIING WATER PIPES, OCTOBER, 1947

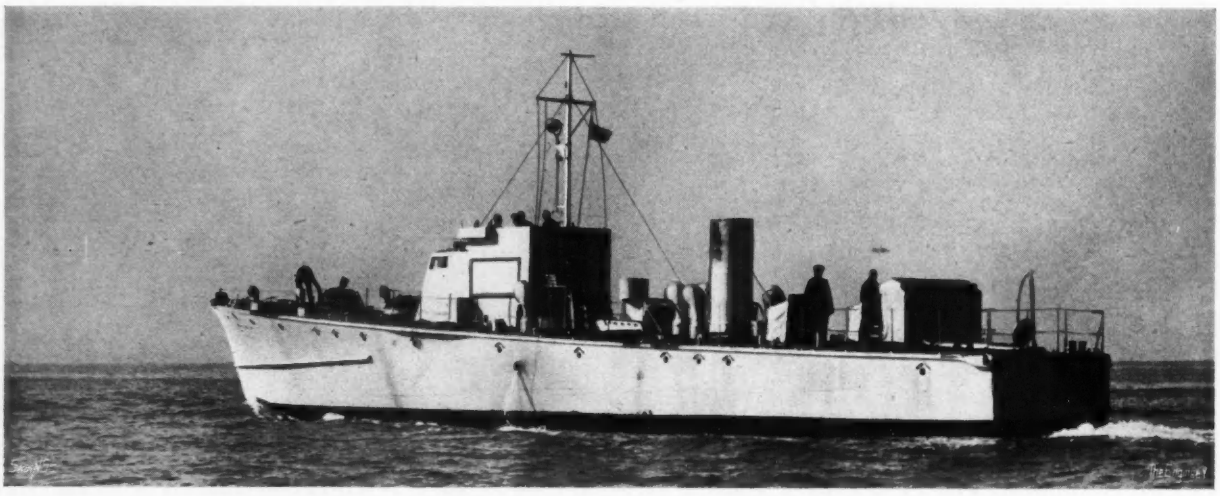
SOME GENERATING STATIONS UNDER CONSTRUCTION IN 1947

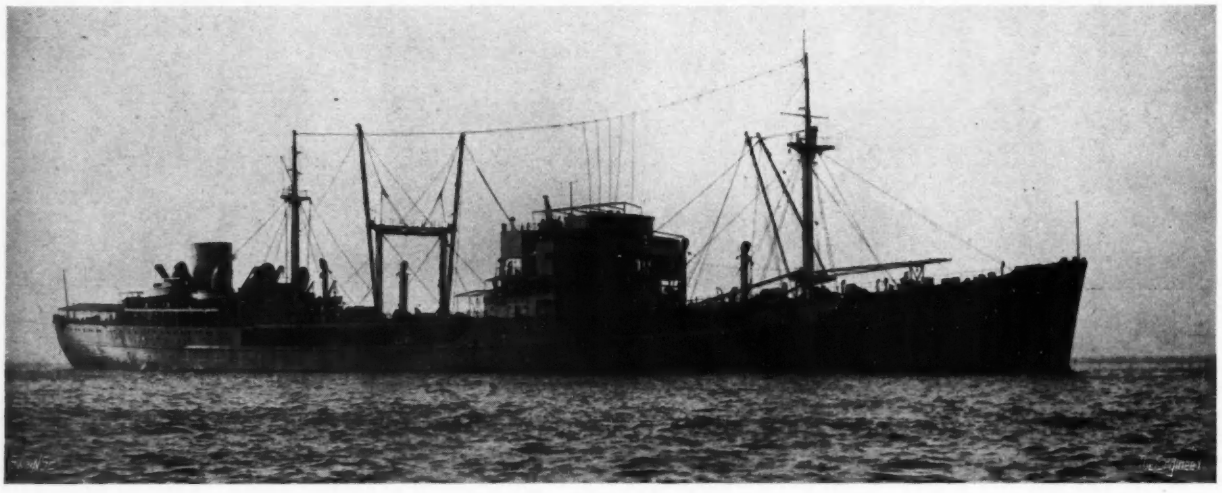


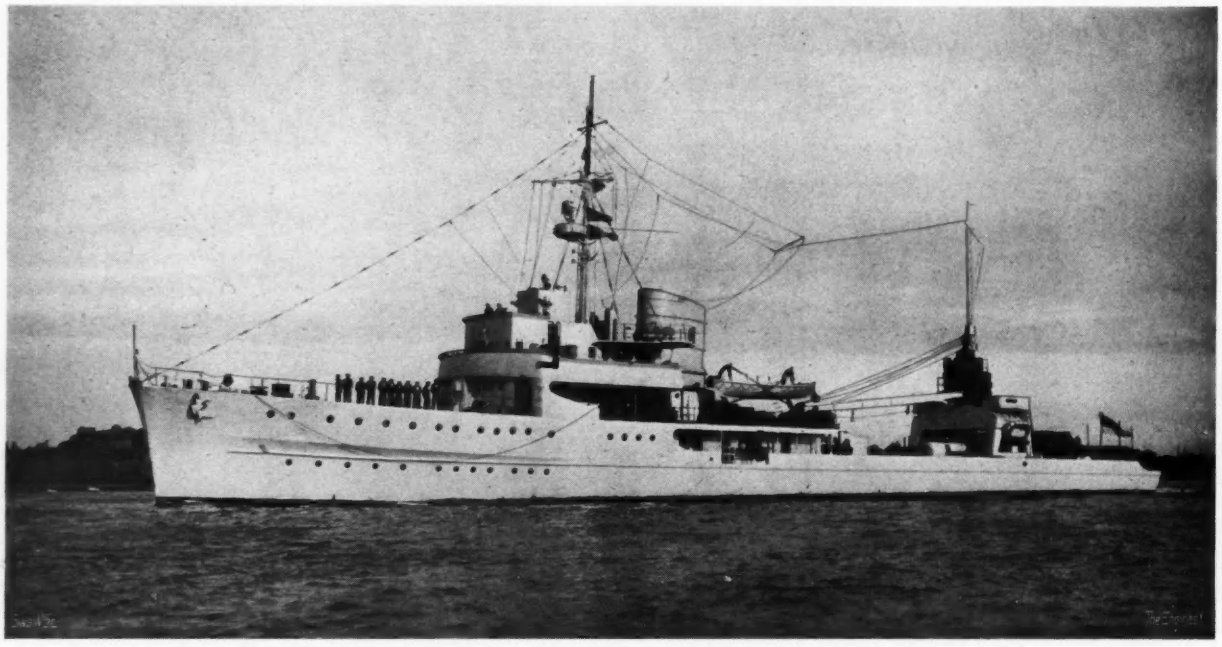


CLIFF QUAY POWER STATION, IPSWICH
KINGSTON POWER STATION—FIRST SECTION

SOME NAVAL SHIPS OF 1947

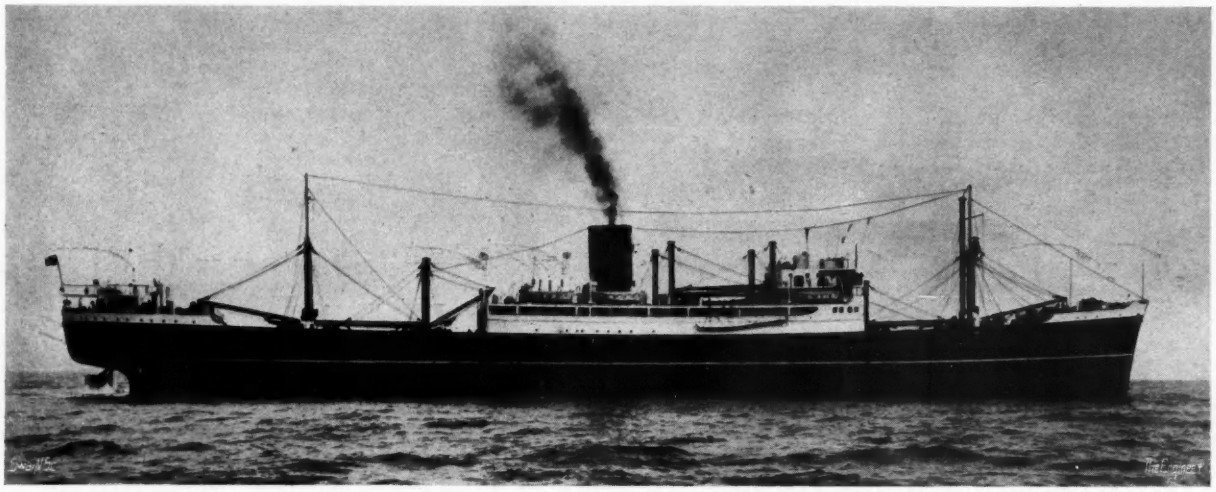


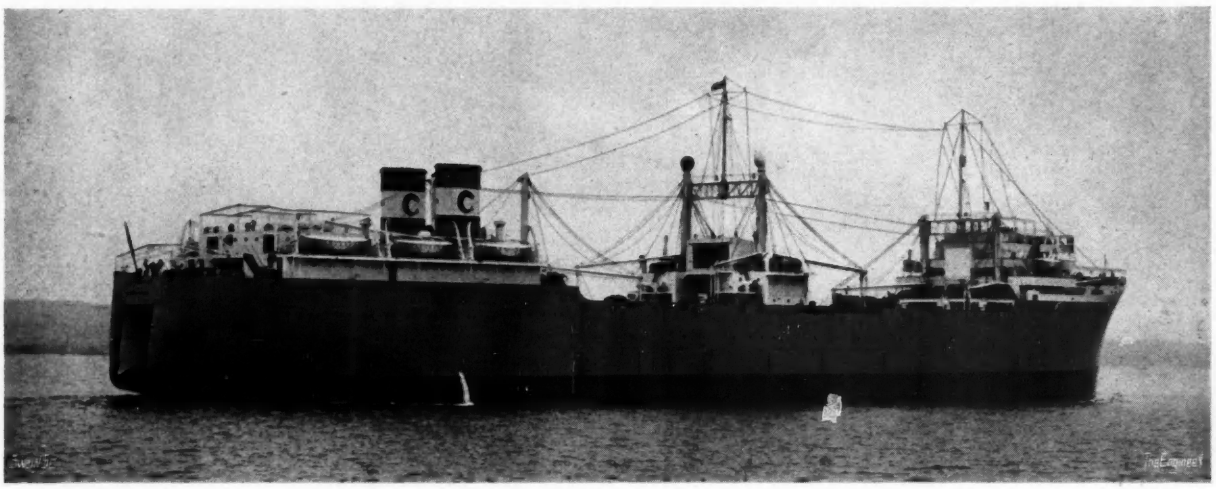


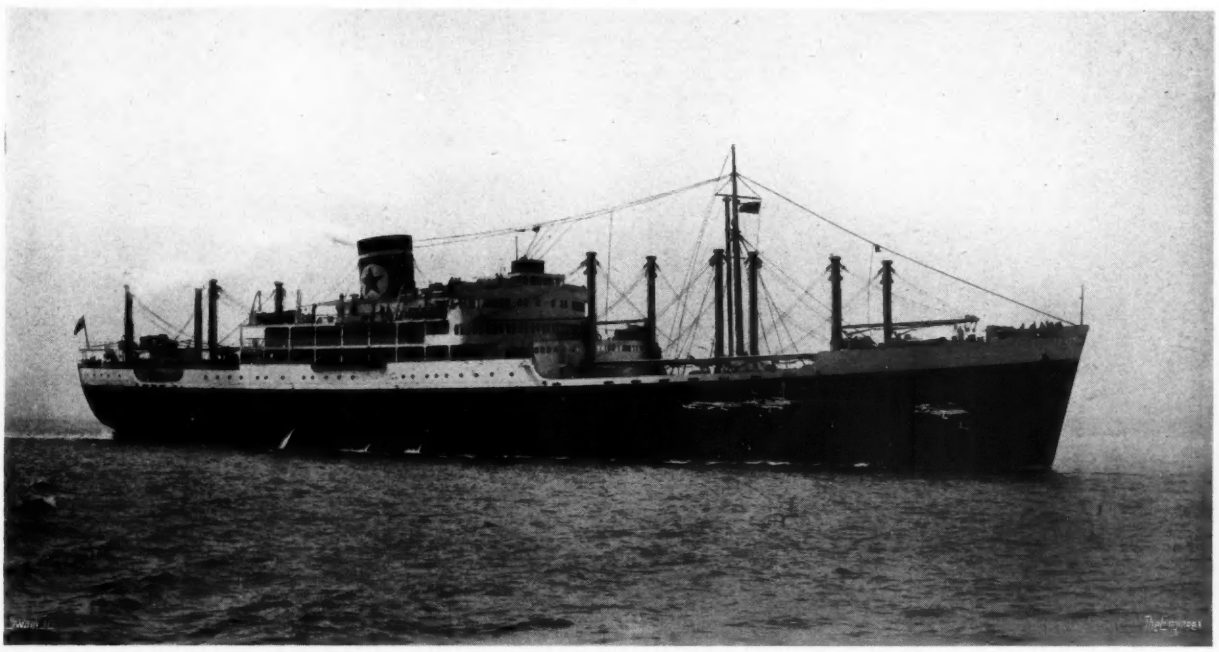


H.M. GAS TURBINE PROPELLED M.G.B. "2009"
H.M. FLEET REPLENISHMENT SHIP "BULAWAYO"
H.M. DIVING TENDER "DEEPWATER"

SOME MERCHANT SHIPS OF 1947

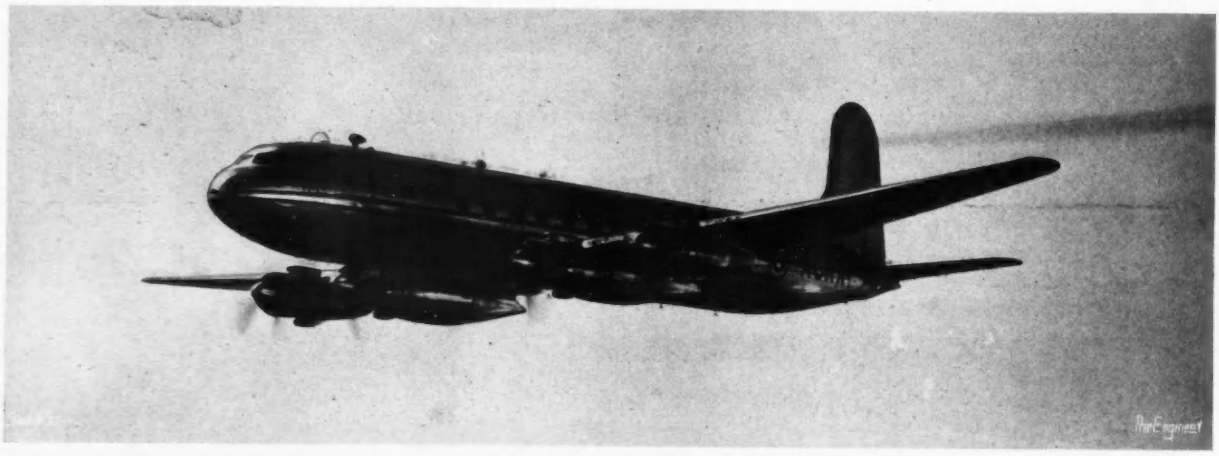


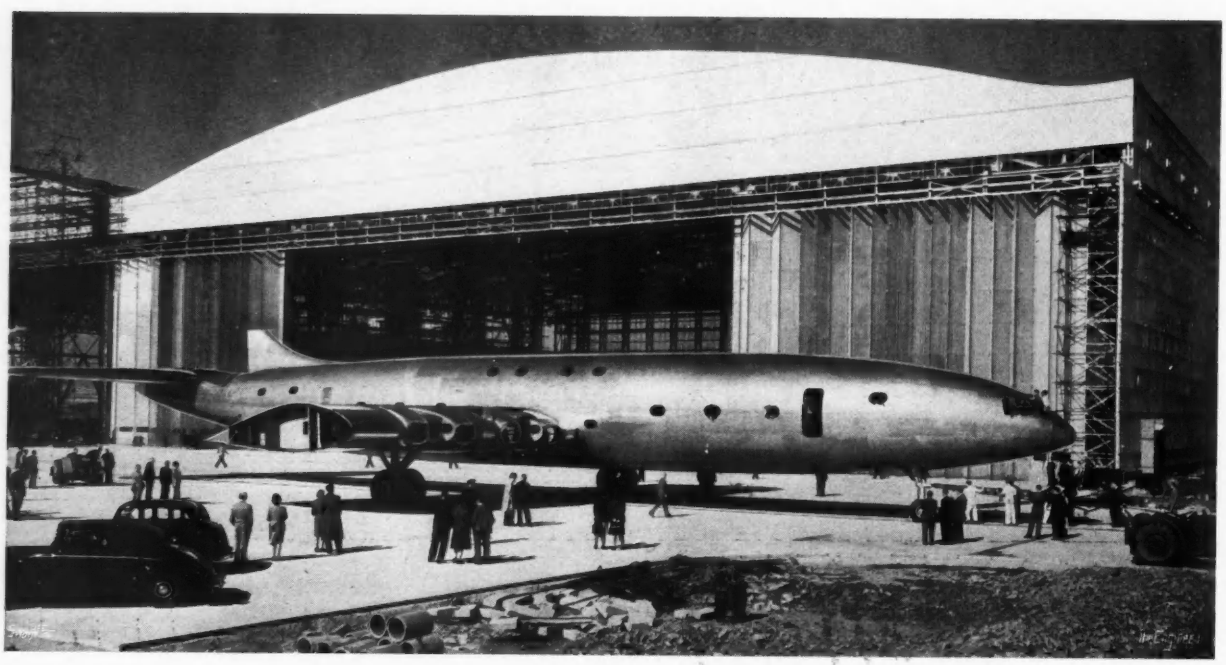




CUNARD WHITE STAR CARGO LINER "ASIA"
MOTOR DRIVEN WHALE FACTORY SHIP "THORSHAVET"
BLUE STAR PASSENGER AND CARGO LINER "ARGENTINA STAR"

SOME CIVIL AIRCRAFT OF 1947



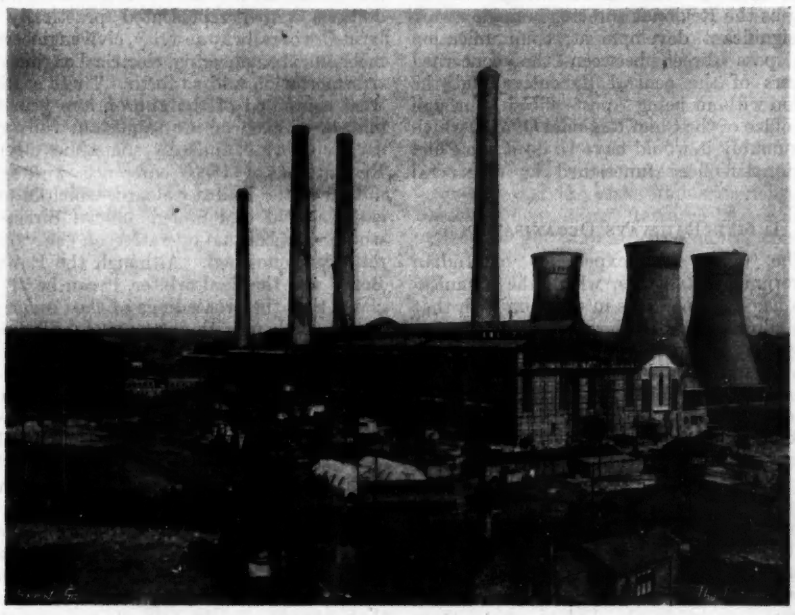


AVRO "TUDOR VII" AIR LINER
AIRSPEED "AMBASSADOR" AIR LINER
BRISTOL "BRABAZON I" AIR LINER

the partly-filled girdle trenches and the excavation of the "dumpling." Rapid progress is indicated in the more recent photograph reproduced opposite, which shows the laying and jointing of the 76in internal diameter circulating water pipes.

When this installation is complete the generating plant will comprise four 50,000kW turbo-alternators with the usual auxiliary equipment. Eight pulverised fuel fired boiler units will be provided, each with a continuous duty evaporative capacity of 300,000 lb per hour. The ancillary equipment will include electrostatic dust precipitating plant, and the boiler units will be served by two 310ft chimneys. The coal will be seaborne, delivered at a wharf which is to be built in the harbour alongside the deep water channel above Poole bridge. A combination of belt and gravity bucket conveyors will carry the coal from the wharf into the boiler bunkers and on to the storage ground adjoining the boiler-house for reclaiming as required. Ash and dust from the boilers will be discharged into barges at a berth close to the coaling jetty, for sea disposal. Messrs. Merz and McLellan are the consulting engineers responsible for the design and construction of the generating station in co-operation with Messrs. Mott Hay and Anderson, who are the consulting engineers for the civil engineering and foundation works.

Considerable progress has been made at the Kearsley generating station of the Lancashire Electric Power Company since October 25, 1946, when we published an account (pages 376–377) of the extensions which will involve the installation of two new 52,000kW sets with eight boilers and two new cooling towers. Both of these cooling towers have now been completed while an advanced stage has been reached in the construction of the main building, as indicated in the view above, which is reproduced from a recent photograph. Site erection has begun on one of the turbo-alternators.



KEARSLEY POWER STATION EXTENSIONS

Any reference, however brief, to the efforts that are being made to increase this country's generating plant capacity would be incomplete without some mention of the work undertaken by the North of Scotland Hydro-electric Board, and this subject will be touched upon in another article reviewing the years' progress in civil engineering. In addition, some of the generating plant on order for the Board's various projects will be referred to in the continuation of the present article, which will deal with British manufacturers' activities.

(To be continued)

Nationalisation of Railways

By N. JOHNSON, M.I. Loco. E.*

No. I

ON January 1, 1948, the ownership and control of the railways of Great Britain passed to the British Transport Commission, and in his announcement to the Press on November 26, 1947, Sir Cyril Hurcomb, Chairman of the Transport Commission, outlined the system to be adopted for the management and operation of British railways.

The text of that announcement was published in THE ENGINEER of December 5th, but it may be a convenience to review those points of the organisation laid down by the Commission which are germane to the present article.

* Lately C.M.E., Burma Railways.

MANAGEMENT AND OPERATION

(*a*) The management and operation of the railways will, henceforth, be in the hands of the Railway Executive, the body established under the provisions of Section 5 of the Transport Act, as the Commissions' agent to assist it in the discharge of its functions. It will be the employer of staff and the body which enters into contracts.

(*b*) The Railway Executive will work largely on a functional basis, each member accepting primary responsibility for certain departments of railway work and the Chairman for the co-ordination of the work of the whole body.

(*c*) The unified railway system is divided into six regions and the same functions as are carried out by the Executive have to be discharged at regional level, except in so far as it may be necessary to concentrate at the centre certain functions, such as finance, rating, law, medical services and police.

(*d*) The functional regional offices will be responsible to and directed by the appropriate functional member of the Executive who will be in direct relationship with them and give them instructions, guidance and leadership. Responsibility for the general administration of the regions as well as for co-ordination, standardisation and other questions of principle, will remain with the Executive. But the regional organisation will be such as to enable matters of local importance to be disposed of quickly at that level, within the powers delegated to Regional Officers.

(*e*) In each region a Chief Officer (Railways) is appointed, whose main responsibility will be to secure that the policies laid down and the general instructions issued by the Executive are made effective; he will co-ordinate the work of the Regional Officers and will have rights of initiative and general oversight necessary to secure that the administration of the region is carried on economically and efficiently and with due regard to the safety of operation.

(*f*) The objective of the Transport Commission is to unify the British railway system and, in doing so, to create an organisation which will avoid the danger of undue centralisation and provide adequate machinery for local contacts and the quick recognition of local needs.

The system of organisation decided upon has attracted considerable attention; Press comment appears to focus its principal criticism on the constitution of the Executive on a functional basis, and on the fact that relationship between the Executive and the regions will also be on that basis, e.g., the member of the Executive dealing with mechanical and electrical engineering will deal directly with the principal officers in each of the regions who are responsible for these subjects and not through the Chief Regional Officer; the reverse will also, of course, be the case, yet the Chief Regional Officer is charged with the responsibility of co-ordinating the work of the regional functional experts, who apparently are not responsible to him.

Two or three comments from the Press may be quoted as representing the general reaction to this form of organisation. *The Manchester Guardian* says: "The new Chief Regional Officers (C.R.O.) have to co-ordinate a number of functional experts who are not responsible to them, but to their opposite numbers in the central Executive. It will need very powerful personality to overcome such lack of powers. If loyalty in the regions should lead to confusion in control, the results may affect the public service" and *The Financial Times*: "... but its great danger is the risk of bringing in the evils of dyarchy. The co-ordinating function is weak at the top (of the Executive) and even weaker in the regions." *The Railway Review*—the organisation of the National Union of Railwaymen—also has sharp

criticism to offer, including a comment that "the whole thing is bureaucracy run riot."

Organisation of French Railways

On the other hand, when taking part in the discussion on Mr. F. A. Pope's paper, "Principles of Organisation for Large Undertakings," which he read before the Institution of Transport on November 10th last, Mr. J. Elliot, who has been appointed Chief Regional Officer, Southern Region, referred to the organisation of the French National Railways (S.N.C.F.) as between headquarters and regions. From reports of Mr. Elliot's description, the organisation would seem to be almost identical with that adopted by the British Transport Commission for British Railways, and, in Mr. Elliot's view, it works very efficiently. His remarks on the question of how the French "have overcome (*sic*) the possibilities of friction" between the "Service Central" (equivalent to the Railway Executive) and the directors of the regions, particularly where subordinate officers are concerned, are most interesting and, in view of the general adverse criticism of the organisation adopted for British railways, deserve wide publicity. From Mr. Elliot's remarks, as reported in *The Railway Gazette*, it appears that each member of the "Service Central" deals directly with his opposite numbers in the regions, on matters of long-term planning, standards of maintenance and so forth, and he calls them to meetings as he finds necessary. Before calling a meeting of Regional Officers he sends to the Regional Director concerned a copy of the agenda or a note of the subject to be discussed, so that the latter may give his officers guidance on matters generally which may affect the region. Minutes of these matters and decisions taken affecting the region are then sent to the Regional Directors for their agreement, and if there should be disagreement which cannot be resolved with the officer of the "Service Central" who held the meeting with the Regional Officers, the Regional Director must report the disagreement to the Director-General with his views. The matter is then resolved as follows :—

The Director-General holds frequent conferences with Regional Directors, at which some or all members of the "Service Central" are present, and at these meetings any points of disagreement are settled by the Director-General between one and the other. As a result of this firm method of grasping the difficulty the number of disagreements is said to be comparatively few.

No member of the "Service Central" on his own authority can override a Regional Director; only the Director-General can do this or his deputies acting for him and with his consent. On the other hand, the Regional Directors, through their frequent contact with the Director-General and the "Service Central," are well aware of the policy to be followed and do their utmost to carry it out. Mr. Elliot also paid tribute to the wonderful progress of reconstruction which has been achieved by the French railways, and was of the opinion that the S.N.C.F. must be one of the most efficiently run railway systems in the world to-day.

So it will be seen that at least there appears to be a favourable precedent for the organisation now adopted by the British Transport Commission. It should, however, be specially noted that in the French scheme no member of the "Service Central" (Railway Executive) on his own authority can overrule a Regional Director, and in this organisation it is clear that with any important scheme being suggested from one of the regional functional officers for consideration by the corresponding official of the "Service Central" or *vice versa*, the Director is in a position at an early stage to register his views, and, if in agreement with the proposals or the principle involved, the specialist officers can be left more or less to develop it.

If he disagrees with the ideas put forward he can have the matter considered at one of the conferences of the Director-General. Such a scheme has the advantage that, so long as the Regional Director is made aware of significant development, communication can pass direct between the concerned officers of the central Executive and the region without being "post-officed" through the office of the Chief Regional Officer, which presumably it would have to do if the Chief Regional Officer functioned as a general manager.

Indian Railways Organisation

The writer has experience of Indian Government Railways, where the organisation has certain points in common with that now adopted for British railways. There was a Railway Board with a President, known as the Chief Commissioner of Railways, and three or four members who were responsible for certain functions, but, at the same time, took joint decision on major policies. Under them came Directors-in-Charge of various specialised subjects, such as civil engineering, mechanical engineering, transportation, commercial, stores, establishment, accounts and so on. There was also a Controller of Standards with a status rather between that of a Director and a Member. One big difference between the Indian organisation and that announced by the British Transport Commission is that, within their schedule of powers and their budget grant as approved by the Central Legislature, the "Chief Regional Officers" were general managers of their system and the specialist officers of individual railways were responsible to the general manager.

Communications between the Railway Board and the "Regions" were addressed to the general manager, who passed on instruction as necessary to his principal officers; similarly the views of the latter officers were represented to the Board by the general manager.

As far as design and standardisation was concerned, the Controller of Standards was responsible and much excellent work was done in his office, but mention might also be made of a very convenient method by which ideas could be discussed and support gained for one view or another, namely the Indian Railway Conference Association (I.R.C.A.), an organisation which existed separately from the Railway Board, although recognised by it. The I.R.C.A. was initiated and developed by the several railway administrations for the purpose of pooling experience and discussing policies. The Association had sections which represented practically all branches of railway activity, civil engineering, mechanical engineering, electrical engineering transportation and so forth. These sections were composed of the appropriate principal officers of each of the important railways; each section met annually, sometimes oftener. Resolutions of the Conference were submitted to the Railway Board, which in most cases agreed and issued official directions which thus became operative on the various railways concerned. Although the Railway Board was the final arbiter, it can be appreciated that the proceedings of the Conference furnished them with a very useful picture of railway activity and how various railways were reacting to similar problems; in addition, as the "top men" in a particular aspect of railway work were gathered together for these discussions, it assisted in "spotting the stars." In England, with a unified railway divided into six regions, there would perhaps not be so strong a case for such a body, but in India, also with so many State-owned and operated systems, it was of great value. The experts on the Board learned from the various conferences things that otherwise might never have come their way.

It is presumed that in the British scheme the relationship and procedure as between the Railway Executive and the regions will be on much the same lines as that outlined above in respect of the S.N.C.F. In the writer's opinion, it certainly would not do for the Chief Regional Officer to have less authority than is implied in the French scheme. In any case, it seems that the organisation as announced for British railways is to be given a prolonged trial, during which, no doubt, adjustments will have to be made. But let us assume that it is within such an organisation that we should consider the functions and prospects of the railway mechanical engineer.

(*To be continued*)

Shipbuilding and Marine Engineering in 1947

No. I

THE year just ended was, in spite of many shortages, one of real achievement in the shipbuilding and marine engineering industries of the United Kingdom. The total output of ships delivered was again probably about the same as the previous year, over 1,000,000, gross tons, but during the year, the industry gradually geared itself up to a productive annual capacity of at least 1,250,000 gross tons. During the twelve months under review, the amount of tonnage laid down was over 1,100,000 tons, and the launched tonnage over 1,000,000 gross tons, while that which could not be completed owing to the shortages of equipment would, if finished, have brought the tonnage completed and laid down to a figure not far short of 1,250,000 tons.

Orders for British and foreign tonnage already on hand amount to over 1,750,000 gross tons, but the shortages of steel, timber, and items of equipment limit the rate of building. In this connection, however, it should be remembered that as a consequence of delays the tonnage launched and fitting out is almost double what it was at any time during the period of the war. Moreover, the class of ship being built is now much more specialised.

Repairing and Reconditioning

Out of a total of some 150,000 men employed in the industry during the past

year more than 80,000 were engaged in ship repairing and reconditioning work, a greater number than was employed at any time during the war on merchant ships. In many cases shipowners preferred to take a repaired or reconditioned ship at an earlier date rather than wait for a new liner or cargo vessel at a later date. That flexibility in our shipyards contributed greatly to the reforming of fleets for the trade routes of the world. Thus it was deemed wise to reopen the cross-channel and short sea routes by completing and overhauling cross-channel steamers and motor ships, including train ferries and to replenish quickly our fishing fleets by converting minesweepers into trawlers. Efforts were made successfully to increase the number of food ships employed in the North Atlantic, South African, Far East, Australian and New Zealand trades and obtain quick turn-rounds, which led to a considerable economic improvement. Among the shipping lines which benefited by new and reconditioned ships were the Cunard White Star Line, the Blue Star Line, the Elder Dempster Line, the P. & O. and Orient Lines, the Shaw Savill and Albion Line, and the Royal Mail Lines and the Union Castle Line.

At the end of 1947 about 70 per cent of the total of ships scheduled for repair and reconditioning were virtually completed, making last year a peak one for this important work. Thus in the present year the volume of this work is likely to decrease. More men should then be freed for shipbuilding activities.

The Future Outlook

Towards the close of 1947, owing to the threatened shortage of oil bunkers, a drive took place to increase the number of tankers afloat. Orders for tankers were placed by both British and foreign oil companies. With these new orders, the amount of tonnage on hand, fitting out, or shortly to be laid down rose to some 3,700,000 gross tons, or about three years' output at the present rate of construction. There are those among experienced shipbuilders who see in this position a possible danger of overloading the industry and, with the present shortage of equipment and fittings, of making the reasonably rapid completion of ships even more difficult than it now is.

The value of shipbuilding orders and work on hand and that either on the berths fitting-out or shortly to be laid down is about £300,000,000, of which one third refers to direct export orders. Reference to shipbuilding in the White Papers on "Economic Survey for 1947," and "Capital Investment in 1948," established the view of the Government that all shipbuilding must be looked upon as export, and at the present time it is quite as advantageous to build ships for British owners as for export, even in cases where the exports are to hard currency countries. Supplies of shipbuilding steel in 1948 seem likely to exceed the quota for 1947 by something like 20 per cent.

British Shipbuilding Research

In last year's review we outlined the formation and the tasks undertaken by the British Shipbuilding Research Association under the guidance of its Council and its Director of Research, Dr. S. Livingston Smith. In the year under review good progress was recorded in the carrying out of the programme already outlined and a number of research reports were prepared and sent out to member firms. Several committees were set up and a number of panels for special purposes were formed.

One of these panels is dealing with "Measured Mile Trials" and its object is to formulate a code of procedure for trials of ships. The task of another panel is that of establishing a "Standard System of Nomenclature" for the Association, which will be shared with the industry. The system of making use of Government, University and Member Firms' research establishments was extended in 1947 and special attention was given to the universities and technical colleges in the shipbuilding areas, where it was sought to encourage both teaching and research and to train men in these specialised spheres, thereby bringing about a closer relation between the shipbuilding and engineering firms and the local educational establishments.

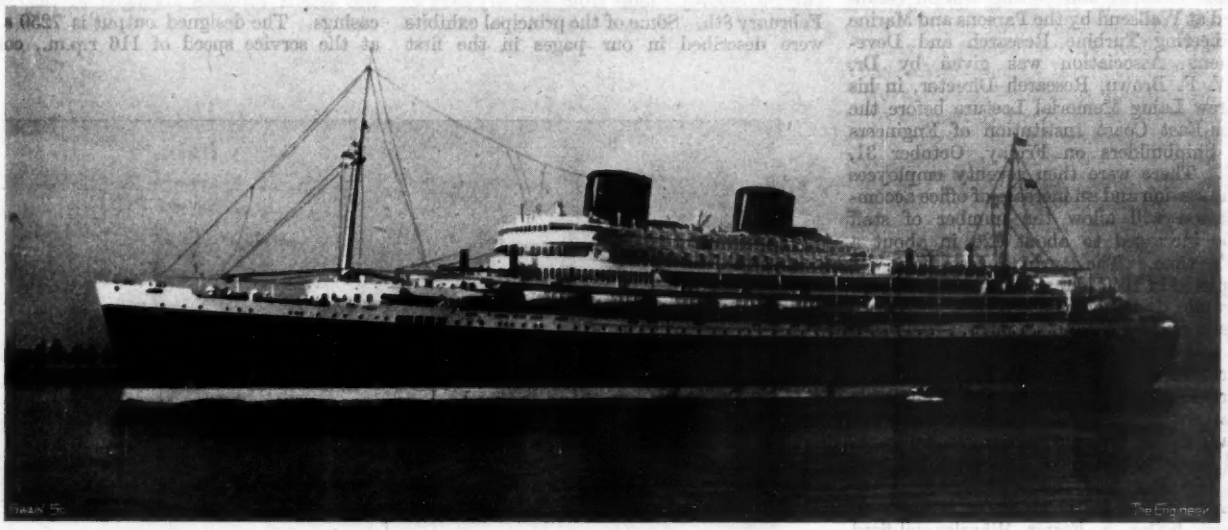
The past year was noteworthy for the co-operation shown between shipowners and the work of the Association. From the outset British shipowners have taken a keen interest in the work of the British Shipbuilding Research Association and have served with shipbuilders and engineers on the committees and panels set up to consider various problems of common interest. They have further advanced research progress by providing facilities for carrying out research work in ships at sea. In 1947, such work was carried out on the "Ventilation of Machinery Spaces," and many readings of temperature and humidity were taken in the boiler and engine-rooms of steamers, and in the engine-rooms of motor ships by engineer officers. The data thus obtained will be analysed by the Imperial College, London. Tank work planned and begun in 1947 at Teddington included the carrying out of experiments to fill gaps in the existing knowledge of the resistance of ocean-going merchant vessels, and to supplying design information. A methodical series of tank tests for a number of block coefficients were run. An effort is to be made to compare, with a view to standardisation, the results of different British tanks, and this work may eventually be extended to tank tests made in foreign tanks.

On the structural side, the determination of load stresses and deflections in structural members of ships was being studied. The work is parallel to that undertaken by the Committee on Ship Welding. The Imperial College was and is carrying out work on a box-type girder, comparable with a hull form, which is being made the basis of an experiment. Launching data were also being surveyed and studied.

Work on the engineering and steel manufacturers sides included that on the expansion of boiler tubes into tube plates. A survey of existing sources of information on this subject was also made. The distribution of stress in nuts which are subject to heavy pulsating loads was investigated, and also the fatigue stress in bolts and nuts under combined bending and tensional loading.

The question of noise in the engine-rooms of motor ships received attention and actual measurements were made in the engine-room of a cross-channel motor ship by the Physics Division of the National Physical Laboratory.

The maximum bearing pressure and rubbing velocity of crankshafts in oscillating bearings was investigated and the fatigue strength of shafts, shaft couplings and crankshafts. The work was done by the engineer-



ROYAL ROTTERDAM LLOYD LINER "WILLEM RUYS"

ing research staff of Lloyd's Register of Shipping, and Lloyd's Register has also worked on the improvement of methods used for the calculation and measurement of hull vibration, and in connection with this special work a new type of vibration exciter was built and tested by W. H. Allen, Sons and Co., Ltd., at Bedford.

In the section on "Ship Performance," emphasis was placed on the development of improved instruments for recording pressure and thrust on trial trips carried out at sea. Various types of torsionmeter were calibrated, and a new type of torsionmeter is now on test. Trial records were analysed and efforts were made to correlate tank test data with actual trial trip records and with service performance. The *Journal* of the Association appeared each month and it contains most useful abstracts from current technical literature.

Pametrada Research Station

A full illustrated account of the marine turbine research and testing station established at Wallsend by the Parsons and Marine Engineering Turbine Research and Development Association was given by Dr. T. W. F. Brown, Research Director, in his Andrew Laing Memorial Lecture before the North-East Coast Institution of Engineers and Shipbuilders on Friday, October 31, 1947. There were then seventy employees at the station and an increase of office accommodation will allow the number of staff to be increased to about 120 in about a year's time. The turbine test bay was completed in 1947 and a Heenan and Froude hydraulic dynamometer designed to absorb powers up to 60,000 s.h.p. was delivered and assembled. This machine is reversed by reversing the dynamometer bodily in its frame and when so reversed is available for astern running tests. For handling the dynamometer and turbines a 75-ton overhead crane is provided. Between the turbine test bay and the boiler-house is the research house, in which there is the permanent boiler, a Foster Wheeler oil-fired unit, built by Richardsons Westgarth and Co., Ltd., and having an evaporating capacity of 32,000 lb of steam per hour at 1200 lb pressure and 950 deg. Fah. total superheated temperature. A second stage superheater is being constructed by Foster Wheeler, Ltd., for giving an outlet temperature and pressure of 1150 deg. Fah. at 1100 lb per square inch gauge pressure. This boiler is worked on distilled water only. The main experimental boiler-house is designed with room for two of the largest naval boilers. It will enable them to be fired under closed stokehold conditions.

A 1150 deg. Fah. test turbine was under construction. It will be loaded by a steam brake and it will be used to investigate distortion problems and joint tightness. Performance and endurance trials will also be made with this set. Provision was made for back-to-back tests of gearing, for which a "Utility" turbine of 3500 s.h.p. output was built. Two further 4000 s.h.p. turbines were acquired from the Admiralty and a Heenan and Froude, Ltd., "Dynamatic" brake is used to load them at speeds between 3000 and 4000 r.p.m. Other apparatus in the research house includes a thrust and bearing tester by Michell Bearings, Ltd., designed to examine bearing losses and thrusts at speeds above 180ft per second.

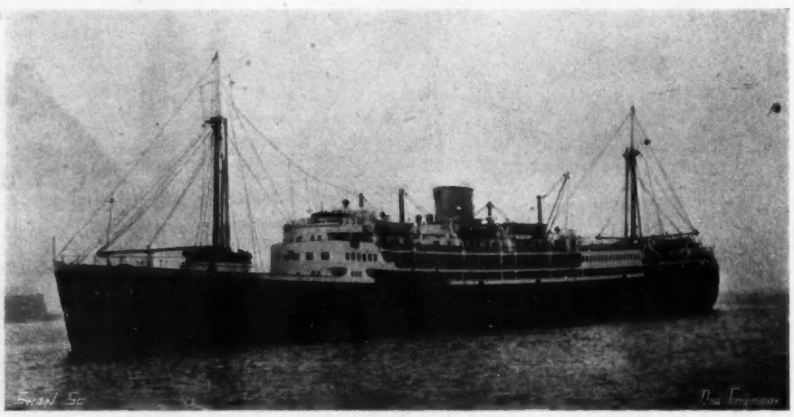
An axial compressor with six stages was installed for testing blades and diffusers, and a series of hydraulic couplings for ahead and astern driving were developed and will be tested. The first tests will be on a prototype steam turbine and before the end of 1948 gas turbines will be tested.

In the research house there is also an l.p. air plant for cascade testing of blading and nozzles. There is a turbine and combustion research building with h.p. air test plant and on the upper floor combustion chamber and heat exchanger testing bays, and a sprayer testing laboratory.

Other laboratories include an electronics laboratory and a gear measuring and testing laboratory and also metallurgical and fuel and lubricating oil laboratories. Apparatus for photo-elastic investigation is also available.

The Worshipful Company of Shipwrights Exhibition

The exhibition arranged during 1947 by the Worshipful Company of Shipwrights was designed to show the great strides made in ship construction and it well fulfilled its object. We doubt whether as many ship and engine models were ever brought together as those which were shown in the Royal Horticultural Society's halls from January 28th to February 8th. Some of the principal exhibits were described in our pages in the first three months of last year. A permanent record of the papers read was made by publishing them in book form.



Elder Dempster Passenger Liner "Accra"

Some Ships of 1947

At the end of July the Cunard White Star liner, "Queen Mary," returned to her North Atlantic service, after one of the largest conversion jobs ever undertaken in any merchant ship. It was carried out by workmen of John Brown and Co., Ltd., from Clydebank. A description of that work will be found in our issue of August 1st. Towards the close of the year the "Queen Elizabeth" was withdrawn from service for some weeks for overhaul, after a very successful operating period. In the early part of the year Cammell Laird and Co., Ltd., completed the reconditioning of the "Mauretania."

In April there sailed from Liverpool to Montreal the first of the Cunard White Star Company's post-war built ships. She was the cargo liner "Asia," built by Sir James Laing and Sons, Ltd., of Sunderland, and engined by Richardsons Westgarth and Co., Ltd., of West Hartlepool. She is illustrated in one of to-day's Supplements. The "Asia," which recently completed her sixth round voyage to Canada and back to Liverpool, has an overall length of 480ft, a breadth moulded of 63ft 9in, and a depth moulded to the upper deck of 34ft, with a gross tonnage of 8750. Her deadweight carrying capacity is approximately 11,500 tons. Modern hatches and cargo-handling gear and the latest safety and navigation equipment have been included in her design. Excellent accommodation for officers and crew is provided, with mechanical heating and ventilation on the Thermotank principle. Insulated spaces for cargo and food transport are served with Sterne ammonia compressors, and Sternette freon compressors. The single-screw propelling machinery comprises a double-reduction-geared turbine taking steam from two Foster Wheeler water-tube oil-fired boilers. The working pressure of the boilers is 480 lb per square inch and the final superheated steam temperature 750 deg. Fah. The turbines are of the latest Brown Boveri Richardsons Westgarth design and incorporate improved blade sections, special labyrinth glands, a hollow low-pressure rotor and a fabricated low-pressure turbine casing, with a drained exhaust portion. There are h.p. and l.p. ahead turbines, with the astern turbines arranged in the ahead casings. The designed output is 7250 s.h.p. at the service speed of 116 r.p.m., corresponding with a loaded service speed of 15·5 knots. On trial in the light condition, a speed of 17·6 knots was recorded. The sister ship, the "Arabia," constructed by the same builders, was completed and will shortly sail on her maiden voyage.

Another Cunard White Star ship was the passenger and cargo liner, "Media," which, in August last, entered the company's Liverpool-New York service. She was fully described and illustrated in our issue of September 5th, and has an overall length of 534ft, an extreme breadth of 70ft, and a loaded draught of 30ft 2¼in. On a gross tonnage of 7482 tons she has a general cargo capacity of 371,430 cubic feet, and an insulated cargo capacity of 60,050 cubic feet, and she carries 251 passengers. Her designed service speed is 17 knots. The entire promenade deck of the ship is devoted to the public rooms, all of which are air-conditioned. There is a fine lounge at the after end of the promenade deck and the cabin accommodation for the passengers and that for the officers and crew reaches an unusually high standard. The propelling machinery was constructed by the shipbuilders, John Brown and Co., Ltd., of Clydebank, and it consists of a twin-screw arrangement of Parsons geared turbines, taking steam from two Yarrow side-fired boilers at a pressure of 430 lb per square inch and a final temperature of 750 deg. Fah. Electric power is generated

by four Ruston-Hornsby G.E.C. oil engine-driven 375-kW generators.

At the Belfast Yard of Harland and Wolff, Ltd., the sister liner, "Parthia," neared completion during the year.

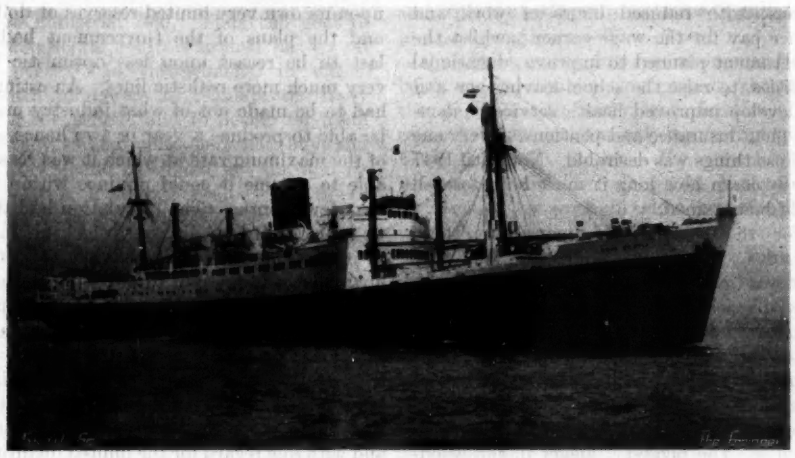
In to-day's Supplement, we illustrate the "Argentina Star," one of two ships completed by Cammell Laird and Co., Ltd., of Birkenhead, for the Blue Star Line, Ltd., for the owner's South American service. The sister ship was the "Brazil Star." The length overall is 501ft, with a beam of 68ft, a depth of 39ft 6in, and a maximum draught of 30ft 6in. The gross tonnage of the "Argentina Star" is 10,750. The insulated holds and 'tween deck spaces are especially designed for the carriage of chilled suspended cargo and citrus fruits, and have a capacity of more than 440,000 cubic feet, in addition to which about 60,000 cubic feet are reserved for general cargoes. Excellent accommodation including public rooms for about sixty passengers is arranged in spacious staterooms on the bridge and passenger decks.

An interesting ship of the year was the new whale factory ship, built for the A/S Thor Dahl, a famous Norwegian whaling company, by Harland and Wolff, Ltd., at Belfast. A view of the motor-driven vessel is reproduced in one of to-day's Supplements. She has an overall length of 560ft, with a breadth moulded of 77ft, and a depth to the flensing deck of 56ft, and to the factory deck of 39ft 6in. Her deadweight carrying capacity is approximately 21,000 tons. Her flensing deck has a length of 291ft and a breadth of 77ft. The deck machinery includes capstans, winches, and derricks, for handling the whale carcases, which are hauled up the skidway through the split stern of the ship and after being cut up are dropped through various small hatches into the boilers and plant in the factory below. The factory has a length of 336ft 2in, is 77ft wide and is equipped with twenty Kvaerner whale boilers, and there is also glue water and separating machinery.

The whole of the plant is motor-driven and the connected electrical load is over 700kW. The cargo oil tanks have a capacity of 21,000 tons and the oil bunkers of 2600 tons. Evaporators to produce 250 tons of fresh water per day are installed.

The propelling machinery consists of twin-screw six-cylinder four-stroke engines, with a bore of 740mm and a stroke of 1500mm running at 110 r.p.m. The boilers for auxiliaries and process work are six in number and are of the single-ended multitubular pattern designed for oil-firing. The electrical generating plant comprises four Harland 220-V 425-kW generator sets. There are also two 100-kW oil engine-driven sets, with a 35/40-kW motor generator and a 35/40-kW steam-driven set for 110-V current.

A passenger ship of unusual interest, which started on her maiden voyage to Batavia early in December, was the Royal Rotterdam Lloyd liner "Willem Ruys." A short description of which was given in our issue of November 28th. She was designed and constructed by The Royal de Schelde Company, of Flushing, in collaboration with the Rotterdam Lloyd Company's naval architects and engineers, and was intended for 1941 service, having been laid down early in January, 1939. During the German occupation of Holland, her well advanced hull and machinery was at first proceeded with under German orders and was then prohibited, although work was continued secretly. It is of interest to record that the oil engine-driven generator sets of the ship were at one time used to supply current to Flushing when that city was relieved. Work was begun shortly after liberation, and the ship was named "Willem Ruys," in honour of Willem Ruys, who with four other Dutch hostages was shot by the Germans in August, 1942.



JOHNSTON WARREN LINES' STEAMSHIP "NOVA SCOTIA"

During her trials off Cornwall the ship attained a full speed of 24·6 knots, when developing 30,500 s.h.p., and with a draught of about 24ft.

As will be seen from an engraving on another page, the ship has a very distinctive appearance. Her bow has a bulbous forefoot, not unlike that of the "Bremen," and the hull design, and that of the propellers and funnels, were worked out by Professor Troost at the Dutch experimental tank at Wageningen. By adopting multiple-geared oil engines with magnetic slip couplings, it was possible to gain one complete deck, compared with a triple screw direct-drive arrangement, at the expense, however, of a slightly longer engine-room. The machinery arrangement is interesting and we shall refer to it in a later article. The length between perpendiculars is 609ft 10in and the beam 82ft, the depth being 54ft and the loaded draught 29ft 2in. The service speed is 21 knots. With a measurement of 21,300 tons, the "Willem Ruys" has a deadweight capacity of about 7500 tons. She is designed to carry passengers in four classes. The lifeboats it may be noted, are high up between the "A" deck and the lower promenade deck and provide shade for the cabins on "A" deck; they are carried in Schat davits and the boats are of Birmabright aluminium and were made by the shipbuilders.

A feature of the design is the first-class lounge, which has a gallery with large windows, giving an excellent view over the sea. The main lounge on the starboard side leads through a wide corridor, furnished with writing tables, to the smoke room, which, again, has large windows. On the port side is a library, which can also be used as a chapel. The second and third-class public rooms are well designed and tastefully furnished. Most of the public rooms are air-conditioned on the Carrier principle and at night-time this system is connected to the Winsor louvre ventilation system, which is common to all classes and to several other parts of the ship. Swimming baths are provided and in accordance with Royal Rotterdam Lloyd traditions provision is made for children who are given special recreation spaces, dining rooms and play rooms.

Early in September the Walker yard of Vickers-Armstrongs, Ltd., completed the "Nova Scotia," which is the first of two ships ordered by the Johnston Warren Lines of Liverpool for its services to Halifax, Nova Scotia, St. John's, New Foundland, and Boston. The ship has three decks and is designed to carry seventy-three first-class and eighty tourist-class passengers in addition to cargo in four holds and the upper and lower 'tween spaces. The following are the principal dimensions of the new ship.

Length between perpendiculars, 415ft; breadth moulded 61ft, and depth moulded to the upper deck 25ft 6in. Her gross tonnage is 7438 and she has a designed speed of 15 knots. The propelling machinery, which was built at Barrow-in-Furness, consists of 6000 s.h.p. single-screw Parsons single-reduction geared turbines taking steam at a pressure of 450 lb and a final superheated temperature of 750 deg. Fah. from three Yarrow oil-fired water-tube boilers of the single flow pattern, with superheaters and air heaters. There are two 550-kW geared turbine-driven generating sets and the Hall CO_2 refrigerating plants are electrically driven. At the end of the year a second ship, the "Newfoundland" was nearing completion in the same yard.

At the Barrow-in-Furness yard of Vickers-Armstrongs, Ltd., one of the completed ships of the year was the "Accra," which, along with the "Apapa," now approaching the fitting-out stage, was ordered for the Liverpool West African service of Elder Dempster Lines, Ltd. Her overall length is 471ft, with a beam of 66ft and 25ft 6in draught, and with a measurement of 11,585 gross tons she has an estimated deadweight tonnage of 6857. The public rooms and cabins for the 245 first-class passengers and the third-class passengers are well planned and laid out, and provision is made for carrying coastal passengers on deck between West African ports.

Twin-screw Vickers-Doxford four-cylinder oil engines are installed, designed to develop 9400 s.h.p. at 118 r.p.m. In order to assist quick manœuvring, air brakes are fitted to each of the main shafts aft of the main engines. Electric power is developed by four Allen 275-kW oil engine-driven generators, and there is a Paxman-Ricardo emergency lighting set. A view of the ship during trials is reproduced on another page.

(To be continued)

THE ENGINEER

JANUARY 2, 1948

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FOUR-PAGE SUPPLEMENT—SOME GENERATING STATIONS UNDER CONSTRUCTION IN 1947; SOME NAVAL SHIPS OF 1947; SOME MERCHANT SHIPS OF 1947; SOME CIVIL AIRCRAFT OF 1947.

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A Retrospect

WHAT a doleful year was 1947! We should prefer, were it possible, to send it to its account like Hamlet's father, "Unhousel'd, disappointed, unanel'd, no reckoning made," with all its imperfections on its head. For 1947 was a year of disillusionment and disappointment, a year in which the rosy post-war hopes of building here a new Utopia, good to look upon, "the envy of less happier lands," crashed irredeemably upon the rocks of hard economic necessity and the obstinacy of human nature. Yet a reckoning there will have to be. "What's past is prologue." To-morrow grows out of yesterday as a tree sprouts from its seed. There is no escape. The events of 1947 have already cast their shadows before them, building a framework upon which the happenings of the present year must inevitably hang. If only because there is that continuity, it is worth looking back to see with what hopes, and with what premonitions, the year opened; to observe how the fears of a fuel crisis, scouted by the Minister of Fuel and Power during 1946, were justified in the very first quarter of 1947; and to feel again the agony of the premature exhaustion of the dollar loan, planned originally to support our economy far into the present year, if not beyond it, but effectively used up by midsummer of 1947 when "convertibility" was ended. Between the wars economics seemed a poor dull dry subject, fit only for bankers and people of peculiar psychology to study. During 1947 we all learnt how closely economic facts could influence the rounds of our daily lives.

There is some magic in war conditions that breeds in men a wholly illusory optimism about the ensuing peace. Forced by mortal necessity to fight for mere existence, man seems to find escape from the memory of present destruction in planning creatively what wonderful things he will do when peace returns. Difficulties are glossed over. The monetary cost is disregarded. Labour is assumed to be abundant. All things seem possible. In 1918 a new Britain was to be built, "a land fit for heroes to live in." Nor did we learn much, it seems, from the disillusionment of the "twenties." The post-war plans of 1945 carried, indeed, more prosaic titles. There was to be "full employment" and "social security." But the very same idealism ruled beneath the surface. The people were to be rehoused, slums were to be eradicated, no one was to be poor or needy, new satellite towns were to be built upon new and tidier principles, industries were to be modernised and made more efficient and the conditions for workers within them were to be improved, and more time, money and energy were to be devoted to research so that Britain should lead the world in design. All that work of improvement was to go forward simultaneously with the repair of war damage, the overtaking of deferred maintenance and the building up again of our merchant marine. It was to be combined, too, under the plans of the trades unions, with reduced hours of work and higher pay for the wage earner; whilst the Government planned to improve educational facilities, to raise the school-leaving age and to develop improved health services, unemployment insurance and pensions. Every one of those things was desirable. Not until 1947 did we learn how long it must be before all could be obtained.

For the schemes of men, like those of mice, "gang aft agley." The rosy post-war plans of the Government depended essentially upon a rapid increase of industrial output to levels unparalleled before the war. Only by so rapid an increase of output could a home market starved of goods but flush of money be satisfied and sufficient exports be made to pay for essential imports. The biggest "nigger in the woodpile" was the persistently low output of coal from the mines. Never more sharply than in 1947 did events bring home to the people of this country their dependence for prosperity upon adequate supplies of coal. It is true that there were subsidiary difficulties. So much was being undertaken all at once that there developed a serious shortage of manpower. Moreover, the monetary inflation made money available to support football pools, amusement arcades, racing and gambling and many other individuals and organisations unproductive of useful goods, so absorbing manpower that might more usefully have been employed elsewhere. There was, too, some shortage of power generating capacity, so that electricity "cuts" were frequent and sometimes prolonged; and steel and various other scarce raw materials had to be rationed by systems of priorities. But it was the failure of coal supplies in February that first broke Governmental plans that were based on an unreal assessment of the capabilities of industry. Despite remarkable ingenuity exercised by engineering and other firms up and down the country in bringing what power generating capacity they could find into operation, for a fortnight over wide areas of this country industrial production was brought almost wholly to a stand. And even when power supplies were restored, industry had been so dislocated, schedules had been so much upset and so much delay had been imposed on deliveries that recovery was slow. Not until well into the summer could it be regarded as complete.

THE DOLLAR LOAN

As bad was to follow. For the period of the conversion of industry to peacetime production and for that during which industry was to be modernised and re-equipped for a greater and more efficient output the Government depended upon the dollar loan from America to balance a deficiency in our oversea trading account. That loan was planned to support our economy well into, if not, indeed, beyond the present year. But with the coming into force in July of the "convertibility" clauses of the loan agreement the dollar credit melted rapidly away, a heaven-sent gift to a dollar-hungry world. By August, when "convertibility" had to be revoked and what was left of the loan temporarily frozen, but £100 million remained. That loss of loan support necessarily drove this country back to depend upon its own very limited reserves of dollars and the plans of the Government had at last to be recast upon less optimistic but very much more realistic lines. An estimate had to be made not of what industry might be able to produce a year or two hence, but of the maximum rate at which it was reasonable to assume it could produce within the next few months. The calculation had then to be extended to discover what minimum of imports was essential and thence to find how great a fraction of total output must be exported to pay for them. Only that proportion of total output that remained (probably rather less than two-thirds) could be allowed to reach the home market. Under the Cripps plan issued in September the calculation was made in detail, industry by industry, and with due regard for the limited quantities of coal and steel and other scarce materials likely to be available. In deference to the imperative need to press up exports and the undesirability of contracting too far the quantity of goods available for the home consumer, the Government found itself forced to contract plans made for capital developments at home. In November there was issued a White Paper showing how £180 millions of capital expenditure was intended to be saved. Events thus forced upon the Government that deflationary policy which its critics had been advocating for many months. Under the Cripps plan we hope to attain a balance in our export/import account by the middle of the present year and at a level of some £1700 millions annually.

These two tragedies, the fuel crisis of a bitter winter and the dollar crisis of a brilliant summer, were the major events of 1947. The first demonstrated how unwise it is to concentrate upon the achievement of ideal aims, whether economic, industrial or social, without pausing to assess sufficiently the influence of hard, practical difficulties standing in the way; the second forcibly brought home to the Government, and its effects brought home to the people, the harsh economic fact that this country must depend for post-war recovery upon its own efforts. They were bitter lessons for a country wrapt in rosy dreams to learn.

Controls

A year ago, even only six months ago, industry was growing restive under the persistence of controls. The war that had made controls obviously necessary seemed long past. Conversion to peacetime production appeared nearly complete. In the engineering and allied industries output was exceeding that of 1938. Yet industry still found itself fettered by the need to fill up forms and make returns, and to argue with apparently unsympathetic Government departments before it could stir hand or foot, extend its works, enter new markets, or make new products. In September, as a consequence of the dollar crisis, controls, far from being released, were made all the tighter. Under the Cripps plan it was made clear that industrial firms would be forced to export, whether or not it seemed to them profitable or desirable so to do, on pain of the withholding of steel allocations if they did not do as they were told. A certain measure of control was even restored over labour through an Order making it possible to "direct" those who fell out of employment, and another intended to draw "spivs and drones" into the productive industrial fold. Thus the goal of the relaxation of controls seemed further off than ever. The Government, in effect, extended its powers to regulate the daily lives of the people, and to decide for them what they should or should not buy, and what they should or should not do, and its powers over industry became even more complete. It became able to tell industry what it should make, where its products should be sold, and even, to some extent, of what materials they should be made. But the governmental view that the extension of controls was an unfortunate necessity forced upon it by the dollar situation cannot be allowed to pass unchallenged. It appears to be a necessity only if it be accepted as unwise that any change should be permitted in the internal economy of the country. Were excess purchasing power seeking an outlet for expenditure to be reduced by a more aggressively deflationary policy labour would be automatically diverted, without "direction," from unproductive to productive employment, and the consequent increased production combined with reduced monetary demand would make goods and materials less scarce and therefore less in need of rationing or control. That policy may be suspect on the grounds, socially, that it might create unemployment and, industrially, that it might breed an unfortunate competition in price whilst hampering reconstruction. But it was and is a possible alternative. The Government exercised deliberate choice in deciding to abjure it.

Research and Development

But if the tightening of controls could only be regarded as a further impediment upon the efforts of industry to increase output there were other activities of the Government which were intended to be more helpful. It may, indeed, be questioned whether there is in reality as much value as is believed in the confusing and complex array of councils, boards and committees to study, to advise upon or to control this, that or another activity or problem that the Government started to set up as soon as it gained office, and which it continued to extend during 1947. But such of those bodies as are concerned with research have as good a chance as any to prove their worth in coming years. In a peacetime world of trade soon to become competitive the Government sees in the extension of research a means not only of improving the products that this country could offer to the world as exports, but also a means of increasing output through the discovery of more economical methods of production or the substitution of new and more efficient devices for old. Much attention was therefore devoted throughout 1947 to the further extension of research services and activities. Not only were research bodies set up by industry itself encouraged to expand, but the Government itself took a hand. Early in the year there was set up an Advisory Council on Scientific Policy to keep it in touch with the needs and problems of every branch of scientific activity. A few months later came the constitution of the Mechanical Engineering Research Board, under the chairmanship of Dr. H. L. Guy, secretary of the Institution of Mechanical Engineers, and with a membership inclusive of eminent practical engineers. This Board is to act as the advisory body to a special organisation being formed by the Government, through the D.S.I.R., to carry out fundamental researches into mechanical engineering problems. The British Hydromechanics Research Association set up in November is intended to work in close co-operation with the Hydraulic Machinery Committee of the same Board. There was also formed during the year under the D.S.I.R. a research organisation under the direction of Sir Claude Inglis to be concerned with loose boundary hydraulics, the *régimes* of rivers and estuaries and coast erosion and tidal problems for the solution of which really large-scale models will be used. That work is likely to prove of particular interest to civil engineers concerned with power and irrigation works in India and other such countries. Just before the end of the year the Government announced the establishment of the Industrial Productivity Committee, a body which, under the chairmanship of Sir Henry Tizard, is designed to assist the solution of industrial and economic problems by the application of scientific research.

Some idea of the scale of research being undertaken in this country by the end of the year was provided by figures in a report issued by the Federation of British Industries, which revealed that British industry was spending about £30 millions annually on industrial and scientific research, and that staffs amounted to 45,000, of whom about 10,000 were qualified scientists and engineers. Government expenditure through the D.S.I.R. for 1946/47 reached £2,390,934. But figures of money expended and workers employed are not wholly to be trusted as a measure of the value of research work. As Dr. Ricardo said in his Presidential Address to the Institution of Mechanical Engineers in 1945: "The skilled research worker, like the skilled craftsman, requires very few tools. . . . An elaborately equipped laboratory in the hands of unskilled personnel would not only produce nothing, but would become a fertile breeding ground of fallacious theories." Those are opinions that the Government and its advisory councils and committees will do well to bear in mind.

Labour

It is certainly pleasant to be able to record that 1947 was industrially almost as peaceful as 1946, itself a remarkably peaceful year. Strikes were few and far between. In engineering, indeed, not one-fifth as many days were lost through strikes during the first ten months of the year as in 1946. Even in coal mining, except for an unhappy dispute at Grimethorpe Colliery, caused apparently by the heavy-handed approach of a centralised body to a matter that should have been considered locally, there was no major dispute threatening a widespread stoppage of work. Yet satisfactory though it is to record such figures, even more satisfactory though it may be to record also that in the final months of the year complaints that labour in the shops was not pulling its weight died steadily down, it could still not be said that the reaction of the unions to the economic situation was wholly encouraging. For during a year when the raising of national output in every possible way was a major issue and when the continued existence of excess purchasing power called for a halt in wage advances, the unions continued to press for shorter hours of work and higher rates of pay. In the first ten months of the year there was an average reduction of about 3½ hours per week in working hours for about five million workpeople and no less than 3,240,000 workers benefited to the tune of £1,018,000 per week in the same period through increases of wages. Such was the answer of the unions to the statement in the "Economic Survey for 1947," issued in February, that "the nation cannot afford shorter hours of work unless they can be shown to increase output per man-year," a statement that has since gathered all the more force as a consequence of the fuel crisis and the dollar crisis. Objection was taken to it on the grounds that it would prejudice the pursuit of claims for a shorter working week in general and set an "impossible standard" by which such claims could be judged. The unions refused also to accept the dictum of Sir Stafford Cripps in the great debate on the economic situation that followed the fuel crisis that "In the long run we should look to the raising of our standard of living along the line of reduced prices and stable wages rather than on the basis of ever-increasing wages and prices and, so far as experience goes, prices always winning." As a consequence the unions made more difficult the Government's task of controlling inflation and hampered it in its efforts to raise production to such a level as could absorb excess purchasing power. What further damage may have been done remains to be seen. Increased wages have already driven up prices of coal, steel and transport, amongst others, and must thereby affect the whole price structure of engineering and other goods. What will be the effect in export markets? As the international sellers' market slowly began to break during 1947 there were certain disquieting symptoms that British prices for many goods might prove too high to be competitive.

Nationalisation

On January 1, 1947, the National Coal Board took charge of the coal mines; during the year an Act to nationalise electricity

generation and distribution was passed and will come into effect early this year; and in the King's Speech at the opening of Parliament in the autumn legislation to bring the gas industry under national control was foreshadowed. When the last of those measures has become law and been brought into effect, the Minister of Fuel and Power will effectively control all the major sources of heat, light and power in this country. What will he do with that control? It is obvious that much fuel is at present inefficiently applied. The average domestic fire, for instance, wastes far more than nine-tenths of the heat in coal and moreover dissipates uselessly the valuable raw materials contained within it. In buying plant not all industrialists and housewives will have chosen wisely between those great competitors of the "twenties" and "thirties," gas, coal or coke, and electricity. How far will the Minister go in attempts to improve efficiency of fuel usage? Will there be widespread changes in charges for gas and electricity? Will there be some special "coke" policy requiring the bulk of coal output to be gasified for the recovery of by-products? Such speculations leap to the mind. But their discussion is out of place in an article that looks back towards the past year rather than forward through the decades.

Yesterday the Transport Act, nationalising the railways and long-distance road haulage and bringing canals and railway harbours under the control of the Transport Commission, began to become effective. Announcements about the organisation and functions of the various executives which will control the main line railways, London transport, the canals, &c., have been so recent that no further reference to them is needed here. Only one further matter demands comment. The Government still desires, despite the obvious difficulties and the disorganisation that would inevitably be caused in an industry that can well feel proud of its post-war record, to see the iron and steel industry nationalised. It is commonly supposed, probably rightly, that the "Parliament" Bill, passed by the Government through the House of Commons in the last months of the year and designed to curb the powers of the Lords to delay legislation, is intended to prepare the way for the passage of an iron and steel industries nationalisation measure at a later date.

Technical Developments

So far this Retrospect has had nothing to say about technical developments in 1947. One of the reasons lies, of course, in the fact that many of the pages of this issue are given up to a review of those developments at a greater length than could be afforded in this article. But there is another. Unquestionably much development did take place during 1947. Yet the more important work was done behind the scenes. New knowledge was gained. But it was applied to experimental rather than commercial machines. For industry was concerned in 1947 more particularly to raise output and there was little reason for the introduction of newly designed machinery or other products when standard, well-proved articles, the manufacture of which was well organised, could be readily sold. An exception must be made in favour of the Philips air engine, developed in Holland, a full description of which appeared in our pages recently. But even a consideration of that unusually interesting machine reveals that to date it has only been built for relatively very small power outputs. A proof of its value for generating outputs suitable for industrial requirements is still awaited. One other event of 1947 also stands out. In M.T.B. "2099" the gas turbine was first applied during 1947 to ships' propulsion at sea. But there is little that is novel in that machinery. A more or less standard Metrovick aero-gas turbine is used as a gas generator, its exhaust gases flowing to an independent turbine driving the propeller shaft instead of to a jet propulsion pipe. Apart from that event there is not very much that we can usefully add to the survey of the gas turbine position that we printed a year ago. There is no doubt that many firms and organisations in this country were intensively engaged upon gas turbine research. But the results of that research, much of which seems to have been concentrated upon combustion problems and the related troubles of deposits on turbine blading, were not incorporated in commercial machines. Even less, of course, can be said about nuclear power. The greater part of the research work into the development of nuclear power is, and remained during 1947, shrouded in secrecy. An attempt is made elsewhere in this issue to review the situation. Perforce, however, it is as much concerned with the international aspects of the control of nuclear energy as with the technical side.

Basic Industries and Economics

Bad as it seemed, 1947 was not all bad. In its final months, indeed, some beams of light broke through the dark clouds of deepening austerity. That very industry, coal mining, the low output of which was the cause of February's fuel crisis, lustred one of them. During December, as though to give the country a cheering Christmas-box, the miners lifted output to levels unreached for many years. Thanks partly to the working of an eleven-day fortnight instead of a five-day week, partly to a small increase in the number of faceworkers, and more particularly to a gratifying increase in output per manshift to 1·12 tons, as compared with 1·06 tons a year before, coal began to be produced at a rate equivalent to 230 million tons per year. May the effort continue! Nor did the steel output figures lack encouraging significance. As the year ran to a close the output of steel reached a level equivalent to some 14 million ingot tons a year, a rate equal to that planned as the average for 1948. Moreover, these high outputs of the mines and the steelworks were barely sufficient to meet the demands of home industries. They suggest, indeed, when comparison is made with pre-war home consumption, not only that the output of the engineering and other steel and fuel using industries is much higher than it ever was before but that if greater supplies became available it could go higher yet. Other figures give support to that impression. The installed generating capacity of power stations reached close on 12,000,000kW by the end of the year, as compared with just over 9,000,000kW in 1940. Despite the practice of economy in domestic demand that large increase of capacity was still insufficient to support winter loading without the staggering of the working day and the operation of heavy industrial power-using machinery during the slacker midnight hours. The loading of the railways became so heavy that a serious shortage of wagons developed and was being overcome at the end of the year only by strenuous efforts to speed their turn-round, particularly at week-ends. Further, the figures of employment, 18,512,000 in home civilian industries and services and manufactures for export, indicate that never before have so many been productively engaged. The corresponding figure for mid-1939 was 16,730,000. Unfortunately, however, productivity was not well balanced. The weight of supporting the export demand fell mainly upon the engineering and allied industries. The output of other industries, particularly cotton and wool, staple supporters of exports before the war, still flagged, despite an encouraging improvement towards the end of the year. Even so, the figures quoted give a fine impression of the great effort Britain made in 1947 and will continue to make in 1948 to emerge from its economic difficulties through enhancement of production; and they provide, surely, the basis for sober confidence in the ability of this country to balance its oversea trading account, as planned, by midsummer.

But the warning was given by Sir Stafford Cripps during the autumn that the balancing of our oversea export/import account at the level of £1700 millions cannot by itself be enough. For there will still remain an unbalance *vis-à-vis* the dollar areas running at an average rate estimated to reach annually £300 million, whilst by midsummer our dollar reserves will have been heavily depleted. No doubt that great plan for U.S. help to Europe envisaged by Mr. Marshall during 1947, but still awaiting the approval of the U.S. Congress, may provide some assistance to this country if only by enabling the Western European nations to recover from the effects of war, thus permitting us to draw thence certain essential supplies which we are at present forced to obtain from across the Atlantic. But neither this country nor those of Western Europe can continue to subsist for many years upon dollar credits. Sooner or later independence of that support must be gained. In the further distance, then, there looms the difficulty of paying for American exports when a stiff tariff barrier limits imports into that great country. But to consider that problem is to look altogether too far into the future. Britain's task in this present year is primarily to recover a balance in her own post-war economy and to do also what she can to aid Europe's recovery, too. As we stand at the gates of a New Year we can say with Schiller:

"Threefold the stride of Time from first to last!
Loitering slow the Future creepeth—
Arrow-swift the Present sweepeth—
And motionless for ever stands the Past."

Let us be done with 1947! It is a dead thing of the Past, fit only for burial. Nor is it worth while worrying too deeply about the problems of the more distant "creeping" Future. In this year of 1948 the concern of engineers must lie mainly with the "arrow-swift" Present.

Naval Construction in 1947

By FRANCIS McMURTRIE, A.I.N.A.

No. I

IN the past year naval construction all over the world has taken second place to mercantile shipbuilding. After six years of war, in which the destruction of shipping was immense, this was only to be expected. A certain amount of reconstruction of naval vessels has, however, been undertaken, and redesigning of incomplete ships in the light of war experience holds promise of future surprises.

There have been a number of instances also of ships built for fighting purposes during the war being transformed into merchant vessels of various types—a reversal of what happened in so many cases during 1939–45.

British Navy

Ships of large size under construction for the Royal Navy and Royal Canadian Navy, in spite of cancellations, still include twelve aircraft carriers and three cruisers. The rate of progress with these hulls, all but three of which have been launched, leaves much to be desired; though it has to be admitted that, in view of the urgent need for mercantile tonnage and the limited supplies of material and labour available, these delays must be accepted as inevitable.

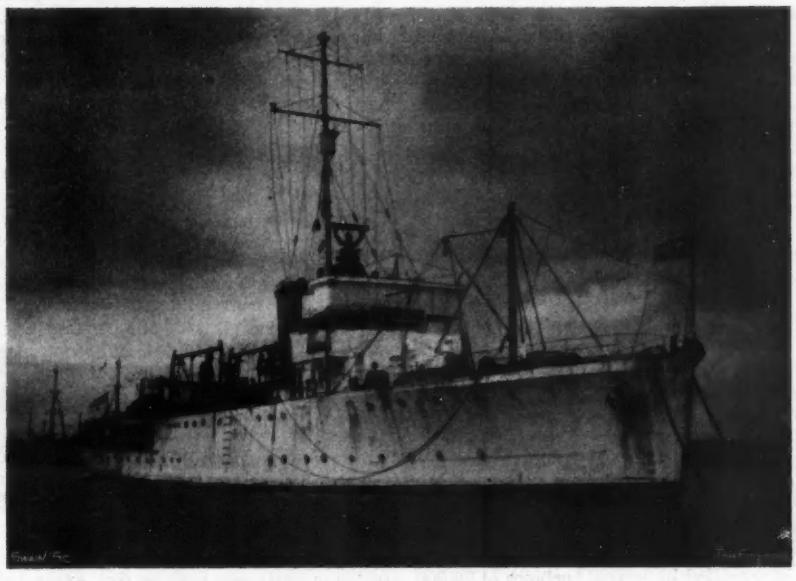
By far the largest units building are the aircraft carriers "Eagle" and "Ark Royal," of 33,000 tons standard displacement. The former, launched in March, 1946, is fitting out at the yard of Harland and Wolff, Ltd., Belfast, while the latter is still on the slip at Cammell Laird and Co.'s establishment, Birkenhead.

Harland and Wolff have also in hand two carriers of intermediate type, the "Centaur," launched last April, and the "Bulwark," which has still to go afloat. Sister ships are the "Albion," launched by Swan, Hunter and Wigham Richardson, Ltd., in May of this year, and the "Hermes," on the slip at the Barrow-in-Furness yard of Vickers-Armstrongs, Ltd. All four are reported to have a standard displacement of 18,300 tons.

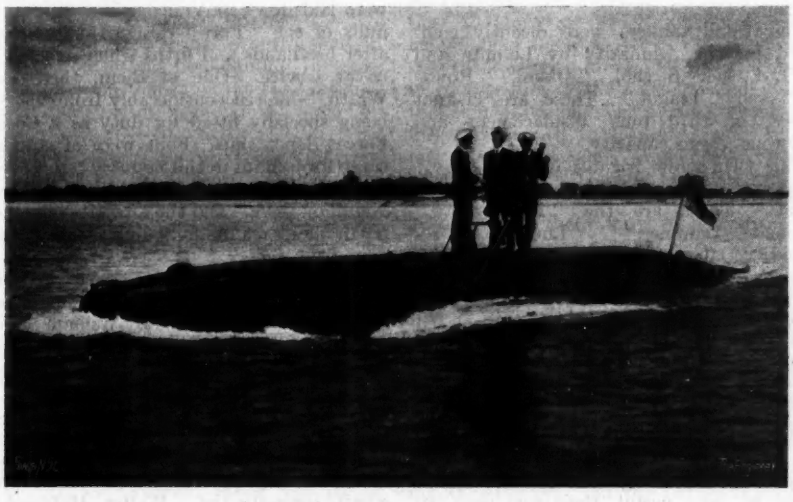
None of the six light carriers of the "Majestic" class, of 14,000 tons, has yet been completed, though all are afloat. The "Majestic" herself is at Barrow, but the "Hercules," after being launched by Vickers-Armstrongs on the Tyne, has been laid up in the Gareloch until it is convenient to complete her. Another Tyne-built ship of this class, the "Leviathan" (Swan Hunter) has been towed to Portsmouth, where she is lying incomplete. The "Terrible" at Devonport Dockyard, and the "Powerful" and "Magnificent" at Harland and Wolff's Belfast yard, make up the half-dozen. The last-named ship, it should be noted, is to be taken over by the Royal Canadian Navy when ready.

H.M.S. "Bellerophon," understood to have been designed as a large cruiser of a new and powerful class, appears to have been definitely cancelled. She was to have been built by Vickers-Armstrongs, Ltd. Three cruisers of the 8000-ton "Tiger" class, all under construction in Clyde yards, are at a standstill. Their names are "Blake" (Fairfield Shipbuilding and Engineering Company, Ltd.), "Defence" (Scott's Shipbuilding and Engineering Company, Ltd.), and "Tiger" (John Brown and Co., Ltd.). They are believed to be identical in most respects with H.M.S. "Superb," the newest British cruiser in service.

In the current Navy Estimates, provision was made for the laying down of two destroyers, "to embody novel features in ship and engine design." No further information has been released concerning these ships, though it has been suggested unofficially that one may be propelled by gas turbines.



FLEET MINESWEEPER H.M.S. "SEAGULL" CONVERTED TO SURVEYING CRAFT



H.M. MIDGET SUBMARINE "X.VII"

So far as can be ascertained, there are eight destroyers of the "Daring" class on order or under construction, though none appears to have reached the launching stage. Yarrow and Co., Ltd., are to build two, the "Decoy" and "Diana," and the following firms one each:—John Brown and Co., Ltd. ("Diamond"); Fairfield Shipbuilding and Engineering Company, Ltd. ("Delight"); Alexander Stephen and Sons, Ltd. ("Defender"); Swan, Hunter and Wigham Richardson, Ltd. ("Daring"); John I. Thornycroft and Co., Ltd. ("Duchess"); and J. Samuel White and Co., Ltd. ("Dainty"). Particulars are stated to be as follows:—Standard displacement, 2610 tons; length over all, 390ft; beam, 43ft; mean draught, 12¼ft.; armament, six 4·5in, ten 40mm Bofors, six torpedo tubes. Horsepower and speed have not been reported.

All four destroyers of the "Weapon" class are completed or have reached the trials stage. On a standard displacement of 1980 tons these ships mount only four 4·5in guns, instead of six, as originally proposed, with six 40-mm Bofors and ten torpedo tubes. The engine-rooms are reported to be arranged *en echelon*. In appearance the ships are quite novel, and in the opinion of most observers uglier than anything that has been seen at sea for a long time. The fore funnel, a long narrow uptake, turned over at the top somewhat like a ventilating cowl, is completely enveloped by the lattice work of the foremast, while the other funnel, a much shorter erection, is sited a good distance further aft.

These destroyers are of all-welded construction, extensive use having been made of the latest method of prefabricated sectioning. This is based on a system of continuous

traverse and vertical welds, completely girdling the ship. Most of the welding is done in the shops, assemblies being of the maximum size practicable.

As completed, the "Battleaxe" and "Broadsword" differ somewhat from the "Crossbow" and "Scorpion." Whereas the former pair carry their four 4·5in guns in one twin mount forward and a second aft, the latter have all four guns mounted in pairs forward, as in the "Battle" class destroyers.

The ex-German destroyer, "Z 38," launched in November, 1941, has been commissioned under the White Ensign for experimental purposes and is now known as H.M.S. "Nonsuch." Her standard displacement is reported to be 2650 tons, the full load figure being over 3500 tons. She is propelled by geared turbines of 70,000 s.h.p., steam being provided at 1250 lb working pressure by six Wagner boilers. When surrendered, her armament comprised five 5·9in, six 37mm, and sixteen 20mm guns, with eight torpedo tubes.

In the division of surrendered Japanese naval tonnage, at least seven destroyers are reported to have been allotted to the Royal Navy and delivered in Hong Kong. Their names are given as "Hagi," "Maki," "Sumire," "Take," "Kusunoki," "Natsuzuki," and "Yukaze." What use, if any, will be made of them, has not so far transpired.

The majority of the all-welded submarines of the "A" series, sixteen in number, have now been delivered, H.M.S. "Anchorite" having been accepted in November. The two last of the class were launched this year, the "Acheron" at Chatham Dockyard in March, and the "Artful" by Scotts' Shipbuilding and Engineering Company, Ltd., in May. Eight-cylinder diesels of 4300 b.h.p. and electric motors of 1250 h.p. are reported to give speeds of eighteen and eight knots on the surface and submerged, respectively. Of the ten torpedo tubes, four are external (two forward and two aft), and six internal (four forward, two aft). Twenty torpedoes are carried.

A dozen of the midget submarines which performed such surprising feats in the war are still in service—"X E 1" to "X E 12," of 30 tons. They are 53ft in length and have a surface speed of 6½ knots.

One of the smaller German submarines surrendered to the Allies and allotted to the British, understood to be of the "Walther" type, has been commissioned under the White Ensign. She is now H.M.S. "Meteorite," though formerly known as "U 1407."

A number of minor war vessels have been added to the Royal Navy as the result of the final division made of the remnants of the Japanese fleet. These include the escort vessels "Amami," "Fukae," "Habuto," "Kanawa," and "Kurahashi"; minesweepers numbered 11, 16 and 102; a patrol craft numbered 21, and transports numbered 19 and 110.

At least two ex-German motor torpedo boats (the so-called "E-boats," which the enemy knew as schnellboote), are still in service for experimental purposes. These are "S 208," powered by Mercedes-Benz 20-cylinder, V-banked engines of the "518" type, giving a maximum speed of 38 knots with 9000 b.h.p.; and "S 212," which has similar engines of the "511" pattern, equal to a speed of 36 knots, with 7500 b.h.p. It is reported that the cruising speeds of these craft are four or five knots below the full speed figures.

Additional Admiralty oilers of the "Wave" series have been taken over during the past year. There are now twenty of these tankers in service, of which twelve were built by the Furness Shipbuilding Company, Ltd., Haverton Hill-on-Tees; six by Sir James Laing and Sons, Ltd., Sunderland; and two by Harland and Wolff, Ltd., Govan. With a cargo capacity of nearly 12,000 tons, these useful ships unite a maximum speed of 15 knots.

Four small tankers were recently completed for the Admiralty by Lobnitz and Co., Ltd., the "Birchol," "Oakol," "Rowanol," and "Teakol." These are 11-knot vessels, of 2670 tons' displacement and 1050 tons' cargo capacity.

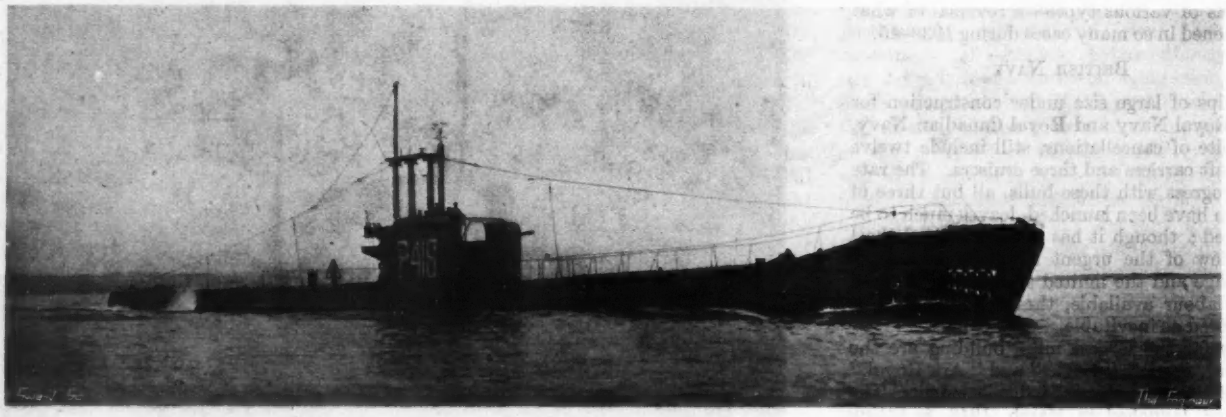
Four twin-screw frigates of the "Bay" type are being completed as surveying vessels. These are the "Herne Bay," renamed "Dampier"; "Luce Bay," renamed "Dalrymple"; "Pegwell Bay," which will probably be named "Cook"; and the "Thurso Bay," expected to be called "Owen." As frigates these ships displaced 1600 tons, and were armed with four 4in, eight 40mm Bofors, two 20mm Oerlikons, and one or two hedgehogs. Weight saved by dispensing with this armament will be available for extra superstructure in the way of chart cabins, &c., and other special equipment. For foreign service these vessels should be very useful, their fuel capacity amounting to 720 tons. Two fleet minesweepers, the "Seagull" and "Sharpshooter," have also been transformed into surveying craft.

An interesting ex-German ship was commissioned recently as H.M.S. "Bulawayo" (see Supplement). Originally launched at Elbing, on October 5, 1937, as the fleet auxiliary "Westerwald," she was renamed "Nordmark" in 1940. On becoming a prize in 1945 she was at first known as the "Northmark"; but to fulfil the terms of a bequest by the late Mr. John Austen, and in compliment to Rhodesia's war effort, this has since been changed to "Bulawayo."

Classed as a fleet replenishment ship, she has space for over 7000 tons of oil fuel, 306 tons of lubricant, and 200 tons of armament stores, in addition to petrol, water and stores of all kinds, including food and clothing. The full load displacement is 22,500 tons, and length overall 549ft. Double reduction geared turbines, of 21,500 s.h.p., were designed to give a speed of 21 knots, but in service she has actually exceeded 22 knots with 23,065 s.h.p. Thus the ship is well suited to her present employment as senior officers' ship of the Fleet Train. It is intended to employ her in various exercises, including fuelling at sea at higher speeds than any previously attempted.

Fuller particulars are now available of the large batch of repair and maintenance ships completed late in the war as part of the Fleet Train for the Pacific. Though about two-thirds of these have reverted to mercantile use, nearly a dozen are believed to remain on the Navy List. Of the total, twenty-two were laid down at Vancouver as mercantile hulls of the "Fort" design, and renamed after headlands and firths when selected for naval service. One of them, the "Cape Wrath," differed considerably from the rest, being specially fitted for duty as a Coastal Forces depot ship. Four were of standard cargo form, built in this country; these were the hull repair ships "Dullisk Cove" and "Mullion Cove" and the aircraft component repair ships "Cuillin Sound" and "Holm Sound."

A new seagoing tender to the "Vernon" establishment, for use in deep diving experiments, is being completed by William Simons and Co., Ltd., at Renfrew. This vessel, which is to be named "Reclaim," has a displacement of 1700 tons, and will be propelled by triple-expansion engines of 1500 i.h.p., equal to a speed of 12 knots. Two ex-German craft attached to the "Vernon" include the diving tender "Deepwater" (see Supplement), formerly the "Walter Holtzapfel," built in 1940. She is a vessel of 1200 tons, powered by two Sulzer diesels of 1750 combined b.h.p., and is capable of a speed of 17 knots. The other craft is the "Clearwater," formerly the "Lumme," built at Kiel during the war. This 62-ton tender is driven by a six-cylinder diesel of 180 b.h.p., the speed being 9½ knots.



"A" CLASS SUBMARINE COMPLETED IN 1947

The old battleship "Ramillies" also forms part of the "Vernon" organisation. Moored alongside her in Portsmouth harbour is the modern cruiser "Royalist," the two together being known as "Vernon II."

Two more obsolete battleships of the same class, the "Resolution" and "Revenge," have been extensively altered to fit them for duty as units of the stokers' training establishment at Devonport, known as H.M.S "Imperieuse." In the case of the "Resolution" the refit included the provision of a whole range of class rooms built on the upper deck, as well as the removal of the armament. It has since been reported that it is intended to transfer the training of stokers to a shore establishment, H.M.S. "Raleigh," in which case these two old ships will presumably be placed on the disposal list.

H.M.S. "Devonshire," selected to replace the obsolete cruiser "Frobisher" as a seagoing training ship for cadets, has had six of her eight 8in guns, with their mountings, removed. "A" turret alone remains in place, the upper deck abaft this being largely occupied by new superstructure used for instructional purposes.

Various ships have been adapted for special duties. Thus the fleet minesweepers "Melita" and "Jewel" have been converted into drill ships for the Tyne and Tay Divisions of the R.N.V.R., and nine motor minesweepers and six other small craft are serving as seagoing tenders to various divisions of that organisation. The sloop "Erne" is to become drill ship for the Solent Division.

Tank landing ships retained in service apparently number twenty-two. All have been given names in place of the numbers by which they were formerly distinguished. Two of the "(Q) 2" type are now the "Ben Lomond" and "Ben Nevis," eleven of the "(3)" type are called after amphibious operations, *e.g.*, "Anzio," "Walcheren"; and nineteen of the "(A)" type have revived names borne by escort carriers during the war, such as "Avenger" and "Tracker."

Quite the most interesting development in warship propulsion during the past year was the fitting of "MGB 2009," attached to the "Hornet" establishment at Gosport, with a gas turbine installation in place of one of her three petrol engines. Trials of this little vessel, illustrated in the Art Supplement, have already been described in THE ENGINEER. It is definitely understood that the next step will be the powering of a larger ship, either an escort vessel or a destroyer, with gas turbine propulsion.

Amongst the many transformations of warships into peaceful vessels may be mentioned the fitting of four corvettes as weather observation ships for duty in the North Atlantic. H.M.S. "Marguerite" became the "Weather Observer," "Snowflake" the "Weather Watcher," "Genista" the "Weather Recorder," and "Thyme" the "Weather Explorer."

Corvettes sold for trading in Chinese waters include the "Begonia," "Amaranthus," "Candytuft," "Freesia," "Heliotrope," "Jasmine," "Lotus," "Periwinkle," "Veronica," "Kittiwake" and "Sheldrake" The sloop "Fowey" has gone to the same quarter. The Greeks have acquired the Canadian corvette "Baddeck," together with several American-built frigates, patrol vessels and minesweepers formerly in the Royal Navy under lend-lease arrangements, all for commercial use. The corvettes "Hibiscus" and "Snapdragon" have both been converted into cargo vessels at Haarlem to the order of Panamanian owners, and are now known as the "Madonna" and "Katina" respectively. Yet another recent conversion was effected by Harland and Wolff, who transformed the corvettes "Chrysanthemum" and "Aconite" into the whale-catchers "Terje 10" and "Terje 11" respectively.

(To be continued)

Coal in 1947

By SIR RICHARD A. S. REDMAYNE, K.C.B.

Organisation and Work of the National Coal Board

THE past year was an eventful one in the history of the Coal Mining Industry of Great Britain, inasmuch as the National Coal Industry Act came into force on January 1st of that year, whereby the State took over about 1500 collieries, the property of some 800 companies, over 400 "small" coal mines, many coke ovens, briquetting plants, attached brickworks, power stations, water works, aerial ropeways and railway sidings. It also became the owner of many thousands of acres of land, of hundreds of farms, villages, houses and cottages, thousands of wagons, many shunting engines, motor lorries, some thousands of pit ponies, and it became the employer of over 700,000 mine workers, in addition to a number of employees on the land and other works mentioned above.

As to the Coal Commission absorbed by the N.C.B., Government Stock was issued in exchange for Coal Commission Stock, the Reserve Fund wound up, and the investments and cash transferred to the credit of the Reserve Fund set up by the National Coal Board.

The Control of the Coal Mines.—All this vast concern is administered by a National Coal Board of six persons, with an extensive staff situated in London. It absorbed the Coal Commission (which had been established under the Coal Act of 1938) and operates through eight Divisional Boards, similar in composition to the National Coal Board, the eight divisions being sub-divided into forty-nine areas, these areas being, in the main, each sizeable, manageable, units. There is an Area General Manager who has a staff of assistants. Beneath the area headquarters there may be set up other agents in charge of groups of pits—each pit being under a manager.

The Marketing of the Coal.—The organisation to carry out the sale of the products derivable from the property owned by the State consists, we have been informed, of a Director-General with three deputies; the latter, in turn, being aided by four Assistant Directors of Marketing. Administration is in the hands of an Assistant Secretary of the Board, attached to the Marketing Department. In the Divisions already referred to, subject to some variations, there is a Divisional Marketing Director, assisted by a deputy and a number of marketing officers. Mr. J. C. Gridley is the marketing member of the National Coal Board.

Projected Developments.—In the country as a whole, we have been informed in the Press, we should see seventy schemes of work being carried into effect during the next few years—that is development of small mines in Scotland and Yorkshire, intensive mechanisation, and so on, which should result in a total additional annual output of from 3,000,000 to 4,000,000 tons, and that about 8000 additional miners would be required for the work. Orders for coalface machinery amounting to £9,000,000 have been placed. These developments cover more or less the "short-term" scheme of the N.C.B.

Of the "long-term" scheme in its development programme, consisting of some hundred projects, the Board hopes to have some twenty in hand by the end of 1948 and some ten more annually in each of the following eight years. It is expected to reach the peak of sixty pits by about 1954 and that all of them will have been completed by 1962. This is an ambitious scheme and one would like to know where it is contemplated the new winnings will be carried out. Presumably the sinkings will be very deep, the cost heavy and the prospects speculative. But it will be possible to lay out the mines on the best possible lines.

With the coming into force of such a revolutionary measure as nationalisation, teething troubles were naturally to be expected in the early days of the operations of the National Coal Board before it got into its stride, but seeing that we were informed again and again by miners' leaders and others, who advocated the change from private to state ownership of the collieries, that its advent would be heralded by peace in the industry and more assiduous work on the part of the miners, it is difficult to understand the troubled state of the industry throughout the year and the prevalence of a high rate of voluntary absenteeism on the part of the miners.

It would seem that the troubles—in some cases, at any rate—have been the outcome of centralisation of administration. The conditions and customs peculiar to the several coalfields are so different that each district has in the process of time evolved and developed arrangements most suited to meet and satisfy these conditions and the miners resent interference therewith. These variations are the more remarkable in view of the close proximity of the several coalfields. Intimate knowledge of these conditions and customs—the latter have grown up through the centuries—is a necessary precedent to the introduction and enforcement of new methods, whether they be in respect of wages, hours or methods of work.

The Coal Board, as Colonel Lancaster wisely said in the House of Commons in July last, "should assume its proper *rôle* as a policy-making and a supervisory body. . . . The Area General Manager should have complete authority . . . under the supervision of his divisional chairman." The miners, as someone has said elsewhere, are not machines for the sake of doing work at the colliery; like most other men they are governed by feelings, by prejudice, by habits much more than by reason, and they are more easily led than driven. It is necessary therefore in seeking to carry out a national policy that the details of its application, in regard to the several coalfields, should be left for decision to those well acquainted by long experience with the conditions and customs characterising the district in question, the National Board contenting itself with laying down the broad policy and leaving the work of negotiating to the district and area boards which

it is to be hoped will be composed of men with wide knowledge of local mining conditions.

Compensation to the Colliery Owners

Since the vesting of the collieries in the National Coal Board not much progress has been made in the allocation of the global sum of £164,660,000 awarded to the colliery owners as a whole. Stage II, which consists in the division of this sum among the twenty-one districts, has not been decided, at the time of writing, by the Central Valuation Board. The sums claimed by the respective District Associations of Mine Owners—the work of ascertainment of which has taken a long time—were all, it is understood, sent in by late November. After the respective allocations have been made by the Central Valuation Board, there is a right of appeal to the Central Board by any dissatisfied district association.

The Coal Industry National (Valuation of Compensation Units) Regulations, 1947, dated June 30th last, were issued by the Ministry of Fuel and Power after consultation with the Central Valuation Board as regards Part II, and as regards such provisions as relate to the practice and procedure of District Valuation Boards, Part IV, under Sections 12, 13, 14 and 17 of the Coal Industry Nationalisation Act, 1946. The District Valuation Boards and the valuation districts with their respective aggregate outputs are as follows :—

District valuation Boards	Valuation districts	Aggregate output (in tons) as mentioned in Regulation C
1. Northern	(1) Northumberland	9,480,900
	(2) Durham	22,080,500
	(3) Cumberland ...	1,028,300
2. North-Western	(1) Lancashire	10,452,100
	(2) North Wales ...	1,902,000
3. Yorkshire ...	Yorkshire	36,697,500
4. Northumberland	(1) North Derbyshire	12,508,800
	(2) South Derbyshire	2,687,100
	(3) Nottinghamshire	14,507,500
	(4) Leicestershire ...	3,054,800
5. Midland	(1) Shropshire	548,400
	(2) Cannock Chase ...	4,237,300
	(3) North Staffordshire...	5,576,600
	(4) South Staffordshire and East Worcestershire	996,200
	(5) Warwickshire ...	4,333,200
6. Southern	(1) Bristol...	48,900
	(2) Forest of Dean ...	873,100
	(3) Somerset	560,700
	(4) Kent	1,219,500
7. South Wales ...	South Wales and Monmouthshire	20,469,500
8. Scotland	Scotland	21,395,900

The Valuation Boards, whose work (known as Stage III in the determination of the Compensation to Colliery Owners) will relate to agreeing the amount of compensation in respect of each of the several colliery units within their districts, have not yet been set up, and it seems unlikely that they will be able to get to work before April, as it is doubtful whether the district allocations will be finally decided before then. Two years from the vesting date was the period presumed for the determination of the amount of compensation due in respect of each unit, during which period the colliery companies will receive one-half their annual revenue (less profits tax, and income tax at the rates then prevailing) for the years 1947 and 1948. But should, as appears most likely to be the case, the work of valuing the several units exceed the two years (it has been asserted by some that it will absorb at least four years) there will be no extension of the "interim income." Only interest (rate undetermined as yet) on the stock will be received. Compensation will be in the form of Government Stock, but, as stated, the rate of interest it will bear has not yet been declared. The stocks of coal wagons and consumable stores transferable to the National Coal Board on January 1, 1947, are to be paid for in cash. Inventories of these have been sent in to the Ministry of Fuel and Power, and when agreed will be paid for. Houses and land will be paid for (as in the case of the collieries) in Government Stock.

Production and Price

Lord Hyndley, Chairman of the N.C.B., in a letter to *The Times* of September 19th last, stated: "The figure of 200,000,000 tons (of coal) for the year 1947 is a production target for deep mines and opencast coal, which was stated by the Government's economic survey for 1947 to be the 'indispensable minimum' for current use and stocking. It was a statement of need, not a forecast of output." This is certainly true if by "need" is meant the measure of the country's internal requirements, exclusive of export.

The T.U.C. put the coal target at 220,000,000 tons, but it is not clear whether this figure included export. The economic survey presented by the Prime Minister to Parliament in March last shows that the present economic crisis underlines the basic importance of coal and power derived from coal. The output in 1946 was 189,000,000 tons, but the consumption was 194,000,000 tons.

Though the annual figures relating to production, averages of costs, pithead price, proceeds, and wages for the past year will not be available for some time in the present year, we are enabled to forecast the trend in respect of some of them from figures which were issued, on October 22nd last, covering the first forty-two weeks of the year.

As to production, there was an increase of 4,750,800 tons over the like period in 1946, namely, 155,746,100 tons, as against 150,995,300 tons in 1946, but 8,050,700 tons were derived from opencast workings as compared with 7,390,300 tons in 1946. So it would appear as if, in the ten weeks remaining, the 200,000,000 tons minimum will hardly have been reached. As to the near future, it must be borne in mind that the quantity of coal available for opencast working is very limited and must soon be exhausted.

Owing, doubtless, to the unusually fine and warm weather which characterised the past summer and autumn, consumption of fuel was lower than in 1946, for inland summer consumption of coal in twenty-four summer weeks in 1947 amounted to 76,301,000 tons, as compared with 78,104,000 tons during the corresponding summer period in 1946. As bearing on comparative production, much turns on relative absenteeism; there was apparently an improvement in this respect, though the position was still far from satisfactory. The figures were given as follows :—

	Week ended October 11, 1947	Corresponding period in 1946
Over the whole personnel :		
Voluntary	4·88	8·03
Involuntary	5·36	6·97
	10·24	15·00
In respect to face workers only :		
Voluntary	8·27	10·44
Involuntary	6·45	8·17
	14·72	18·61

These comparative figures are for one week only in each year: one would have preferred to have had the average for the whole period of forty-two weeks. The same applies to the figures of output per manshift: the figures were :—

	For week ended October 11, 1947	Corresponding period in 1946
Over all workers, tons ...	1·10	1·09
Face workers, tons	2·91	2·80

Had the absenteeism figure been the same as for the average for 1938 (the last pre-war year) the total output would have been 4 per cent higher in 1947 than it will turn out to be. It does seem extraordinary that with all the great extension in the application in the mines of labour-aiding appliances the output per manshift over recent years should show so little improvement as is apparent.

The gravity of the country's position in respect of coal was made evident by the fact that for the first time in our history we became an importing country of that commodity. Coal was imported from U.S.A. and from Poland, that from U.S.A. being paid for by American dollars out of the United States loan. The first consignment was to arrive about August, 300,000 tons to be supplied between the end of July and the end of September, 1947, at a price round about £5 c.i.f.

We have yet to learn what were the comparative average costs of production per ton of coal as between 1946 and 1947, the average proceeds of sale and the average earnings of the miners. As to the pithead price of coal, and as to cost, though no precise average figures are available we do know that, owing to the N.C.B.'s loss of 3s. 3d. per ton, it was decided that after August 31st the pithead price of coal and manufactured fuel should be increased by 4s. per ton, and as from the same date the price of semi-carbonised ovoids was to be advanced 4s. 4d. per ton, and the price of "slurrey" was under consideration. It was decided on December 15th to raise the price of coal again—mined and open-cast—(excluding slurrey) as from December 31st by 2s. 6d. per ton owing to the enhanced cost of production due to extended hours at overtime rates by the miners, estimated at 10d. a ton. This increase makes a total average increase of 26s. a ton since 1939.

It is interesting to know that whereas in November, 1947, the rise, compared with 1939, in the wholesale price of basic materials was 155 per cent, the corresponding increase in respect of coal to January, 1948 will be 133 per cent But in this connection it must be remembered that in the past increases in the price of coal have always been well below those in respect of other basic materials.

Quite apart from the decline in output, the high price of coal would in normal times act as a preventative to export. What loss of coal export means to the nation is epitomised in the Government's Economic Survey for 1947. "The loss of our coal exports since pre-war days is roughly equivalent in value to the whole of our wheat imports." The American and Polish coal which the Coal Board are importing on behalf of the Government costs more than British coal but is being sold at prices in line with British coal, the resulting loss being borne at the Government's request as a charge on the Board's resources, thus spreading the burden evenly over all consumers in the country. The effect of this must be to increase the current loss per ton over British coal from 3s. 3d. to 3s. 9d. The chief item contributory to the increased cost of working is the rise in the wages

lull due to the introduction of the five-day week, we are informed.

The scarcity of coke due to the low output of coal has acted as a brake upon the expansion of the manufacture of iron and steel. With the coming of the National Coal Board old affiliations were broken down and so caused a difficult problem to arise in ensuring a constant supply of coke from new instead of from old services, the latter having been affected by nationalisation of the coal industry.

(To be continued)

Aeronautics in 1947

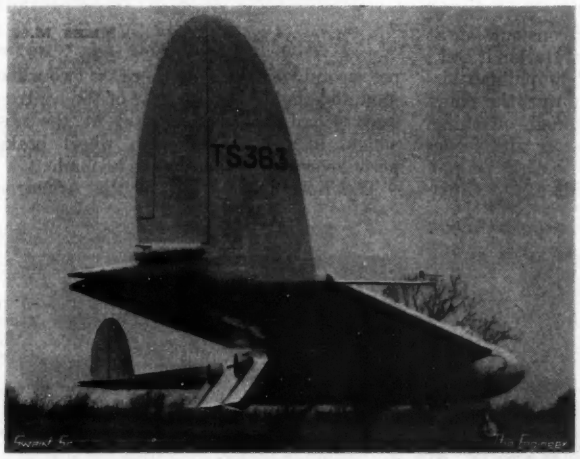
No. I

COMPILING this article last year, in respect of aeronautical developments of 1946, it was possible briefly to refer to a remarkably great number of new British aircraft and power units. Now, reviewing developments of 1947, a partial lull would appear to have taken place.

Amongst reasons for this apparent comparative lack of activity may be adduced, first, that a year ago the ending of the war was still fresh and much information on wartime developments was suddenly released for publication. Secondly, although technical work may proceed vigorously over several years on a new aircraft engine, manufacturers are wont to delay the news until the product has reached perfection, or as nearly so as possible. It is to be hoped that the lack of activity is more apparent than real, and that it conceals solid progress. That this is so is, we believe, largely true, for in spite of the relatively few entirely new machines described in the following account, the British aircraft industry is working in difficult times with unabated vigour.

During 1947 much of the work of reorganisation to bring the industry into line with the economic conditions which we must now identify with peacetime was accomplished. Following the cancellation of wartime contracts, several firms have reorganised sufficiently to achieve a high rate of export of aircraft and engines, though at least one has become a casualty.

Some disappointment must perhaps be felt at the delay in the production of new aircraft suitable for economical long-distance service on airlines, but the gas turbine engine, which was so quickly developed for high-speed fighters in the form of a jet engine, still needs considerable development work to make it economical and reliable for heavier, slower and comparatively low-altitude aircraft such as civil transports. There is abundant evidence that this work is going forward in a spirit of keen competition to produce the new types of engine, but until they arrive, we must be content with interim and less economic types of aircraft.



ARMSTRONG-WHITWORTH "AW.52" JET-PROPELLED TAIL-LESS AIRCRAFT

Civil and Research Aircraft

Progress on one of the biggest ventures in aircraft construction—the building of the Bristol "Brabazon I"—was well maintained during the year. In October a landmark was reached by the transference of the fuselage and inner wing sections of this great aircraft from one part of the maker's works to the new building known as the Assembly Hall at Filton, where final assembly is now proceeding. In one of our Supplement illustrations the "Brabazon I" is shown outside the new hall, and a good impression may be gained from this view of the great size of both aircraft and building.

A description of the machine and of the new building appeared in our issue of October 17, 1947, whilst the interesting mechanical problem of cutting the unusual gearing for the coupled engines was described in these columns on August 15, 1947. The "Brabazon I" is a low-wing monoplane with a wing span of 230ft and a length of 177ft. The fuselage has a maximum diameter of 16ft 9in and the designed all-up weight is 285,000 lb, or about 126 tons. Other designed performance figures are:—Still air range, 5000 miles; maximum speed, 300 m.p.h.; rate of climb, 750ft per minute; service ceiling, 25,000ft. A section of the fuselage, 143ft long, will be pressurised, and accommodation is likely to be provided for up to 100 sleeping passengers or 120 sitting passengers, plus a crew of twelve. Eight Bristol "Centaurus" eighteen-cylinder sleeve-valve radial air-cooled engines are arranged in pairs, each engine of a pair driving one component of a contra-rotating coaxial six-bladed propeller. The total power available at take-off is 20,000 h.p.

Last July the first prototype Airspeed "Ambassador" completed its first flight. A medium-range twin-engined high-wing all-metal civil transport, this machine is representative of the economical and fast class of aircraft required for transcontinental services. Our Art Supplement illustration indicates the clean aerodynamic form, which gives the machine a remarkably wide range of high and economical cruising speeds, said to be from 180 m.p.h. to 280 m.p.h. Its all-up weight at present is 47,000 lb and its engines are Bristol "Centaurus" units, each of 2600 h.p. Because of an expectation of early power plant advances—which have been perhaps a little less rapid than was at one time anticipated—the structure of the "Ambassador" was designed for loadings to give a full return for the use of maximum power outputs in excess of 6000 b.h.p. Thus it is expected, when propeller turbines are available, that the all-up weight and the range of the machine will be considerably increased, to 52,500 lb, and 2000 miles, respectively, with cruising speeds up to 330 m.p.h. It is claimed that the design of the laminar flow wing is such that these increases in the cruising speed will be economically possible. In its present form the aircraft carries up to forty-eight passengers. It complies with I.C.A.O. regulations and can climb safely after take-off engine failure. Thermal de-icing, equipment for pressurisation and a steerable tricycle undercarriage with duplex wheels form part of the initial design. It has recently been announced that a number of these machines have been ordered by British European Airways Corporation, to replace in due course the Vickers "Viking" aircraft at present in service on European services.

The "Tudor" range of Avro air liners was

SHORT "SEALAND" AMPHIBIAN AIRCRAFT PARTLY ASSEMBLED

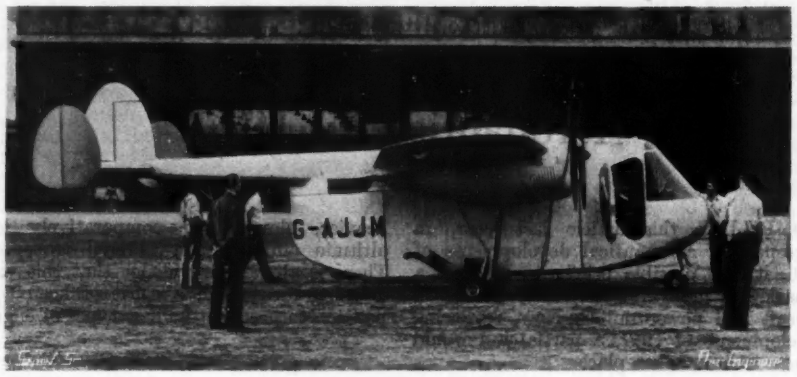
extended during the year by the construction of the "Tudor IV" and "Tudor VII." The "Tudor IV," built for British South American Airways Corporation, went into service in September of last year. Its fuselage has a total length of 85ft 6in, about 6ft more than the basic "Tudor I," giving accommodation for thirty-two passengers, and the wing span is 120ft. The power units are four Rolls-Royce "Merlin" engines.

The Avro "Tudor VII," illustrated in the Art Supplement, was test flown last April. It was built to investigate the performance of Bristol radial engines and is a variation of the "Tudor II," which is the largest aeroplane yet built in Great Britain. Its fuselage, 105ft long, is fully pressurised and can accommodate sixty passengers, with baggage and cargo. Its range is 1420 miles at a maximum cruising speed of 285 m.p.h. at 26,000ft. With Bristol "Hercules" engines the machine is known as the "Tudor VII"; with Rolls-Royce "Merlin" it is the "Tudor II."

An amphibian flying-boat for civil use, of 8700 lb all-up weight, under construction at Belfast by Short Brothers and Harland, Ltd., is the "Sealand." The first amphibian aircraft to be designed since the war, the Short "Sealand" is a twin-engined machine, particularly suitable for charter and feeder line service. It will seat five to eight people, and with two de Havilland "Gipsy Queen 70" engines of 330 b.h.p. each, it is designed to cruise at 150 m.p.h. at 37 per cent power. It is interesting to note that from water take-off has been calculated as 576 yards in 28 seconds, and from land 371 yards, under I.C.A.N. standard conditions at sea level. It is therefore able to work from small stretches of water or land. These figures are based on the present power, limited to 660 b.h.p. When soon the power is increased to 750 b.h.p. the performance should be correspondingly increased. A point in the design is that the land undercarriage is readily removable if operation as a flying-boat only is required. The saving in weight is 500 lb, which can be used for increased useful load or extra range of 500 miles by fitting extra tanks. As an amphibian the range is quoted as 713 miles with 926 lb useful load, or 276 miles with 1400 lb useful load.

Other types of Short aircraft in production are the "Solent" flying-boat and the "Nimbus" sailplane. The "Solent" is the civil version of the R.A.F. "Seaford," and twelve have been ordered by B.O.A.C. for passenger services on the Empire air routes. The hull is divided into two decks and provision is made for thirty-four passengers. With four Bristol "Hercules" engines the cruising speed is 238 m.p.h. at 9200ft. The "Nimbus" sailplane is an interesting newcomer to the ranks of British gliders. Its all-up weight with two pilots is 1200 lb, and full dual control is fitted, the pilots seated in tandem within an enclosed cockpit. The span is 62ft and gross wing area 240 square feet. At 40 m.p.h. the sinking speed is 2·3ft per second. For landing there are two wheels mounted slightly to the rear of the centre of gravity, and a wooden skid at the nose, which, in conjunction with wheel brakes, permit very short landings to be made.

The first flying trials of the Armstrong Whitworth "A.W. 52" jet-propelled tailless machine were announced last month. This aircraft is perhaps the most advanced experimental machine in the world, and it is notable for numerous research features which bid fair to provide data of great importance. An illustrated description appeared in our issue of December 27, 1946, and for a full account of the technical points the reader is referred to that article. Illustrations herewith show the machine in flight and about to land during recent public trials at Bitteswell Aerodrome.



MILES M.68 FREIGHT AIRCRAFT

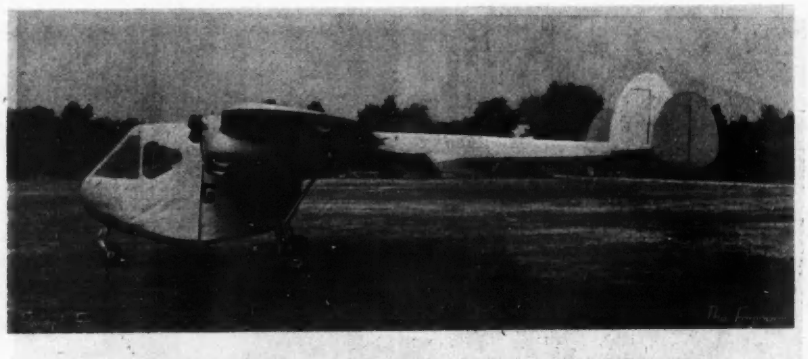
ARMSTRONG-WHITWORTH AW.52 TAIL-LESS AIRCRAFT ABOUT TO LAND

The "A.W. 52" is the central step between the "A.W. 52G" glider and the building of a larger machine of 160ft to 180ft span and perhaps of double the weight of the "A.W. 52," which is designed for 33,000 lb all-up weight, with a span of 90ft. The present aircraft is propelled by two Rolls-Royce "Nene" jet units, each rated at 5000 lb static thrust. Accommodation is provided for a pilot and observer, but a roomy compartment between the engines gives space for extensive instrumentation and for the installation of automatic observation gear. Full performance figures are not yet available, but it is understood that cruising at 330 m.p.h. at 36,000ft the estimated range is 1500 miles and the rate of climb at sea level is 4800ft per minute.

Space in this review does not permit a full description of the novel features of the aircraft, but it should be noted that the wing is of laminar flow construction and is smooth and accurate in contour to a very high degree. Perhaps the most interesting point is the provision of boundary layer suction to counteract wing tip stall. With the introduction of the gas turbine it has been found possible to withdraw air from the upper surface of the outer wing and pass this air through the turbine. This suction comes into operation automatically when either the engines are throttled or when the pilot's control column is pulled right back. The system only comes into operation when the aircraft is approaching a stall; it is not used to improve the performance.

Fins and rudders are fitted on the wing tips, and longitudinal and lateral control are effected by a single surface on each wing, known as the "controller," serving the function of the normal elevator and aileron.

Flying trials took place recently of a novel four-engined freight-carrying machine, pro-



MILES M.68 FREIGHT AIRCRAFT WITH CONTAINER REMOVED

duced by Miles Aircraft, Ltd., in which the freight-hold portion of the fuselage is detachable and can be used as a road trailer. This

BRISTOL "171" HELICOPTER ON TRIAL FLIGHT

aircraft is not yet named, but is known by the type symbol "M.68." As is clear from the accompanying engravings, the freight compartment fits in to form part of the fuselage and takes the form of a detachable box, about 10ft long and 4ft 6in square. It is fitted with removable road wheels and a towing bar, permitting it to be towed on the road. After being flown to its destination the container is removed from the aircraft and another laden container, for another destination, may be fitted in its place. Alternatively, the rear fuselage fairing, normally attached to the rear of the container for flight, can be fitted directly to the back of the pilot's cabin, permitting the aircraft to be flown without the freight compartment. The potential advantages of such an arrangement are evidently numerous, particularly as regards elimination of much handling of goods, with attendant loss of time. A neat point is that when the container is on its twin road wheels the centre of gravity is arranged to occur when it is balanced on its wheels; consequently it is only necessary to check such balance after it has been loaded to ensure that the centre of gravity is correct for flying conditions. This aircraft, based on the design of the Miles "Aerovan," has a payload of 1600 lb for a range of 400 miles, and cruises at 130 m.p.h. with four Blackburn "Cirrus Minor" engines, each of 100 b.h.p. The tricycle undercarriage is fixed, with duplex main wheels and a single nose wheel.

FAIREY "GYRODYNE" ROTATING WING AIRCRAFT

Rotating Wing Aircraft

Although development of helicopters and other rotating-wing aircraft would appear to be further advanced in America than in this country, judging by the number of new designs constantly announced there, several British firms are now making good progress with such machines. Actually built and flown are the Bristol "171" helicopter and the Fairey "Gyrodyne," whilst the Cierva "Air Horse" is nearing completion. Furthermore, Westland are entering the field with the Westland-Sikorsky "S.51."

The Bristol machine is shown above on one of its trial flights. As yet the makers are not willing to give detailed information as to its construction, but it is known that the engines of two prototypes are Pratt and Whitney 450 b.h.p. "Wasp Junior" units and that the Alvis "Leonides," of 550 b.h.p., will be used for production models. The machine is sustained by a single main rotor, with a tail rotor for torque reaction. The rotor blades are mounted on flexible tie-rods and pitch control is by means of a "spider," an arrangement claimed to produce light control forces by reduction of pitch change mechanical friction. Accommodation is provided for four persons, but in the prototypes the rear seats have been removed to permit installation of development instrumentation.

More recently it was announced that the experimental Fairey "Gyrodyne" had successfully flown. This machine we illustrate by reproducing a photograph taken last September at the Society of British Aircraft Constructors' flying display, where the machine was shown on the ground. The torque reaction from the rotor of this aircraft is counteracted by a small variable-pitch propeller, mounted on a stub wing; this propeller also contributes thrust for foward propulsion. The main rotor and propeller are driven by an Alvis "Leonides" engine. An important claim as regards safety is made by the makers resulting from the design of the rotor blades, which are always within the auto-rotative pitch range; thus no rapid action by the pilot is required to avoid loss of rotor speed in the event of an engine failure. The designed useful load for this machine is 1230 lb with a gross weight of 4500 lb.

Another entrant to the field of helicopter manufacture in this country was announced during the year as Westland Aircraft, Ltd., of Yeovil. This firm is to build the American Sikorsky "S.51" helicopter under licence, and it will be known as the Westland-Sikorsky "S.51." Accommodation will be for pilot and three passengers. This well-known design with Pratt and Whitney "Wasp Junior" engine of 450 b.h.p. gives a useful load of 1250 lb, including fuel. In this country it will be alternatively and interchangeably fitted with the Alvis "Leonides" nine-cylinder radial engine.

Finally, the Cierva Autogiro Company, Ltd., is reported to be well advanced with the W.11 "Air Horse" freight-carrying helicopter, which is designed to carry 3 tons of cargo or twenty-four passengers. This machine is to be lifted by a three-rotor arrangement driven by a 1640 b.h.p. Rolls-Royce "Merlin" engine. Expected to be the fastest and most powerful rotating-wing aircraft in the world, its cruising speed is quoted as 116 m.p.h. and maximum speed 154 m.p.h. With a similar lay-out, the "W.12" is a smaller machine, to be fitted with two Alvis "Leonides" engines of 550 b.h.p. each, and designed to carry twelve passengers or 1¼ tons of freight.

(To be continued)

Books of Reference

Universal Directory of Railway Officials and Railway Year Book, 1947–1948. London: Directory Publishing Company, Ltd., 33, Tothill Street, S.W.1. Price 20s. net. In the new edition of this authoritative and interesting directory it has been found possible to include up-to-date official data from several countries, which, owing to the war and internal conditions, the publishers have been unable to revise for some time past. It is pointed out that the nationalisation of railways in many parts of the world suggests that the volume will be of historical as well as current interest in recording for the last time details of many company administrations in a number of countries.

British Non-Ferrous Metals Directory, 1947. London: Metal Information Bureau, Ltd., 39, Jermyn Street, S.W.1. Price 5s. net. This directory has been compiled with a view to providing in a compact form a comprehensive list of suppliers of British raw and semi-finished non-ferrous metals. It is proposed to publish revised and improved editions every two years.

Nuclear Energy in 1947

IN the field of nuclear energy and its control the year 1947 started well; it had the advantage that on the last day of the previous year the United Nations Atomic Energy Commission had adopted a plan for the international control of atomic energy by a substantial majority, ten out of twelve possible votes being in its favour. This carefully constructed scheme which owed much to the earlier work of the American Board of Consultants, under the chairmanship of Mr. Lilienthal, formerly of the T.V.A., and now head of the U.S. Government's own Atomic Energy Commission, proposed the creation of an Atomic Development Authority (A.D.A.), to which all states would surrender that small fraction of sovereignty necessary to enable A.D.A. to manage the whole business on the common behalf. What had thus to be managed was very considerable in extent, though the actual ownership of the uranium and thorium-producing mines was not included. What it did include, however, was the ownership of all the materials refined from the ores, and of the reactors for the production of fissile materials. It was natural in order to ensure the working of such a scheme that the authority should have the power to inspect with considerable freedom where and when it wished in order to ensure that no clandestine manufacture of military weapons was anywhere taking place.

International Control

But immediately the report embodying the requirements of this plan came before the United Nations Security Council objections, very strong objections, were raised by the U.S.S.R.; especially that there should be inspection inside Russia by technicians of other nationalities. This was said to be a completely inadmissible infringement of national sovereignty.

It is difficult to be sure why the U.S.S.R. objected so very strongly to international inspection, seeing that the U.S.A., which had so very much more that would be thus inspected, was willing to accept it; indeed, the U.S.A. was the first to suggest such inspection. Perhaps the reason is that in Russia there is a powerful body of opinion which is disinclined to allow foreign observers to become aware of the general economic state of the country and of the precise location and number of the new big armaments plants beyond the Urals.

The year began therefore with the discussion before the United Nations Security Council of a definite international plan for the control of atomic energy, accepted by a majority of the nations represented on the Commission but not by the small minority of which the U.S.S.R. was the leading spirit. Despite the U.S.S.R.'s objections to the plan, and especially to any idea of international inspection as not only an unwarranted interference with sovereignty, but as a likely cause of interference with industries outside the field of atomic energy, it was surprisingly agreed on June 11th, by Mr. Gromyko, that the U.S.S.R. would, after all, accept the principle of inspection by the new authority provided that it was sufficiently restricted in time and scope to avoid interference with industrial undertakings. There was expressed at the same time, however, a strong objection to the idea that A.D.A. should have any right of ownership of materials or plants or any power of licensing national undertakings. On the other hand, it was agreed that the day-to-day work of A.D.A. should be free from any veto restrictions. This promising change in the Russian point of view was carefully and hopefully considered by the Atomic Energy Commission, but in the majority opinion it left too many loopholes for evasion to make it a sufficiently secure system to commend itself to other states; in particular, it would be unacceptable to the U.S.A., which would be expected to give so much and would in return expect a watertight scheme of control and supervision.

The Atomic Energy Commission continued with its deliberations without limiting itself to the consideration of these counter-proposals of the U.S.S.R.; it considered what, in the light of fuller information, was needed to amplify what had been set out in its first report. And on September 11th it was able to present its Second Report to the Security Council and this, like the first, was adopted by ten votes out of the twelve members of the Commission.

This later Report proved to be somewhat fuller than the first, but the general scheme it detailed had changed little, though it was much more particularised. On the whole, it may be said that the recommendations where they differed from the previous one did so in their greater precision. Certainly it showed no indication of any desire to reduce the precautions to the lower standard of the Russian Scheme. Nevertheless, it does seem to be generally agreed on all hands that in any international control scheme, A.D.A. shall have and control its own research laboratories for the development of atomic energy for civil purposes; and if A.D.A. is to be allowed or required to possess atom bombs (despite their national possession being banned), those research institutions would include development work on military objectives as well as on civil. But whatever the final scope of its research programme, it was hoped and expected that the very working together as a team, on common problems, of scientific and technical experts drawn from many countries would itself produce a useful unifying effect throughout the world.

The main reason for elaborate precautions is the need to ensure that nuclear fuel intended for civil purposes shall not be diverted to military ends. Otherwise there might be a grave risk of this happening, for the bait to the political adventurer would be very tempting. The denaturing procedure originally put forward as a precautionary measure by the Lilienthal Group of Consultants was not found to be the secure safeguard it had been thought to be when it was first mooted. The method was that fissile material in the very pure form needed for the atomic bomb should be so admixed with a sluggish isotope as to make the whole non-explosive, and this without interfering with its use for power production. Such a mixture, once made, would be hard to separate and this, it was thought, would obstruct any plan for restoring the material to a form suitable for military use. Certainly it would delay it, but it would not prevent it. Research work, however, continues, and it may be that some improved method of denaturing will be found which is not reversible; when that day comes some of the many regulations now thought necessary will no doubt be modified or even discarded.

Current Research

On the nature of current research and development work on atomic energy little is available for publication, but we are informed that the first object of the Atomic Energy Research Establishment at Harwell, under the leadership of Dr. Cockcroft, has been the construction of a low-power graphite pile, known as "Gleep," similar to one already in use in Chicago. This pile is surrounded by a shield of concrete some 5ft thick, and it contains several hundred tons of graphite bricks, between which are grooves for rods of uranium metal and uranium oxide. This is essentially a research plant. The next pile at Harwell will aim chiefly at the study of problems of power production. When it is working at the 1000kW power level it is estimated that about a gramme a day of fission products of one sort and another will be produced. It follows that, useful as the power output of a really large plant will be, the quantity of radioactive waste products may prove some embarrassment and will require careful study as to its right handling and disposal.

Information given in the House of Commons shows that it is the intention of the British Government to create at Harwell a "university of nuclear physics," which will be expected to hold its own with any other such establishment anywhere in the world.

The work in the U.S.A. is co-ordinated by that Government's own Atomic Energy Commission (which must not be confused with the Commission of the same name under U.N.O.). The Clinton Laboratories at Oak Ridge, Tennessee, continue their work on the separation of the uranium 235 isotope; plutonium is being produced at Hanford, Washington. Atomic weapons are a responsibility of the Los Alamos Laboratory near Santa Fé, New Mexico. Other laboratories similarly at work are the Argonne National Laboratory near Chicago, the Brookhaven National Laboratory in Long Island, and the Knolls Atomic Power Laboratory at Schenectady. There are others under contract with the Commission and several universities are taking part. The result already attained is the preparation of radio isotopes as a promising research tool in chemistry, biology and medicine, as well as in agriculture and metallurgy.

The Canadian endeavour is naturally on a smaller scale. The Chalk River Laboratory began work during the war and the first atomic energy reactor built in Canada was there located. It was known as "Zeep"—the zero energy experimental pile—so called as it was designed to work at a very low energy level and was intended to be mainly a research instrument. At the present time the activities of this laboratory are directed towards basic research and the peaceful applications of atomic energy. Canada, of course, is rich in natural resources of uranium.

The work in France makes use of locally produced uranium for research investigations which aim exclusively at the civil uses of atomic energy. It is planned that one pile, yielding from 300kW to 1000kW, should be ready by the end of 1948 and one of about ten times the size by the close of the following year. But for the production of a really large plant of, say, 250,000kW a period of some ten years is thought by Monsieur Joliot-Curie to be necessary.

Not much faith need be placed in the story printed in the Paris paper *L'Intransigeant* last November that an atom bomb

weighing only 13 lb. and composed of uranium 235 had been made in Russia and exploded satisfactorily in the neighbourhood of Irkutsk in the presence of "two hundred and eighty scientists and Soviet atom specialists." According to the best Western opinion, so small a bomb would be incapable of maintaining the necessary nuclear chain reaction required for explosion.

Power Plants

It happens that there are more metallurgical and chemical difficulties in the way of designing plants for the production of power than there are for the preparation of atomic explosives, and many years are likely to pass before any material addition can be made to our present fuel supply in this country. No heat engine will work efficiently unless the working medium is at a sufficient temperature, and temperatures that are sufficient are a good deal higher than those at which these piles work when the object is the simple one of producing a military substance. The construction materials used to provide the necessary strength in the power pile need to stand higher temperatures, and their choice is restricted by the essential requirement of freedom from loss of strength even under very intense radiation; hence, it is difficult to find materials which will have, and retain, sufficient tensile strength. It is customary to "can" the uranium rods with aluminium, but this limits the surface temperatures to about 350 deg. Cent. To obtain higher temperatures some better sheathing material than aluminium is needed, but choice is restricted not only by mechanical and metallurgical limitations, but even more by radio-physical properties; only some substance which will pass all three tests, and not be too expensive to produce, will do.

The fact that there are probably years of work necessary before a solution to these problems can be found has made some engineers and scientists, both here and in America, raise the question whether the building of any large-scale plants for the production of power should be undertaken in the meantime. It is suggested that there could be little loss through delay, as at present no one really knows how to design such plants efficiently, and that in the meantime international fears would be allayed if it were known that no large atomic energy plants for any purpose whatever were being built. In the meantime small-scale research work could continue. This is a plausible argument, but difficult to carry to a practical issue as it would be hard to ensure that clandestine large-scale work was not somewhere being undertaken. A condition in which honest states are openly disarmed and dishonest ones secretly equipped is not attractive.

Nuclear fuel for civil purposes will no doubt first find its use in large power stations and possibly in large ships. In both uses the fact that a handful of uranium can produce as much power as a train-load of coal should be of immense service in reducing labour costs in handling the fuel at the power stations and in freeing bunker capacity in ships for additional cargo space. Its adaptability to smaller power installations such as those of aircraft or ground transport, whether by rail or road, is a more uncertain question. In large power stations and ships it should not be difficult to provide for the thick protective shields (concrete, lead or other materials) which at present are necessary to guard the operative personnel from the harmful effects of any radioactivity which may escape from the power plant. The weight of such shields might well prove prohibitive in aircraft. Nevertheless the U.S. Government takes a sufficiently optimistic view of this possibility to have set up a committee of aircraft engineers to consider the making of plans for such a development. If the venture succeeds at all, there should be little difficulty in achieving a good degree of thermal efficiency, but the main inducement will be the possibility of saving almost the whole of the present fuel and tankage load, which to-day is usually more than the payload. The gain from a doubling of the present revenue per mile flown would have a revolutionary effect on airline economics. The adoption of nuclear fuel for surface transport would be less dramatic in its financial return, and its feasibility must depend in large measure on the discovery of some lighter and less bulky means of shielding. It is by no means certain that this is scientifically possible, but one can feel assured that it is one of the many subjects now under diligent investigation.

The Present Situation

We may now ask how far we have got since that August of 1945 when the United States bombers dropped the only two atom bombs they had on Hiroshima and Nagasaki. Despite the immense energy thrown during the succeeding years into the effort to find some control scheme which could be adopted internationally in order that the benefits of atomic energy could be enjoyed without fear, the progress made has not taken us nearly as far as was hoped. Judging from the United Nations discussions most states would willingly accept the American offer to destroy their stockpile of atom bombs in return for an international scheme of the kind proposed by the Atomic Energy Commission. But no truly international scheme is possible until all are willing to agree. The Commission remains at work and if one day there is found to be an easing of the international atmosphere it may be possible for the Commission to reach agreement. That, however, is speculative, and consideration has to be given to some interim alternative. The great scientist, Einstein, has given an emphatic opinion in favour of the inauguration of a complete World State, but there are others who see a danger in such centralisation of power as affording a chance to some political would-be dictator to seize authority and so bring the world under minority control, with the usual consequences.

A more attractive alternative is the adoption of something like the A.E.C. proposals by states willing to do so; that should not be impossible to achieve though a great deal of redrafting would be necessary—in fact, a new scheme would have to be worked out in detail. In the meantime, it appears that the U.S.A. is, very naturally and rightly, preparing itself against possible eventualities, but since she is an essentially non-aggressive state, the world has little to fear in respect of any of these activities, except the fear lest they be not sufficiently effective.

It was recently reported by the U.S. Atomic Energy Commission that, following the precedent of the 1946 tests in the Bikini lagoon, the U.S. Government intends to establish on the Pacific Ocean atoll of Eniwetok a proving ground for the routine experiment and test of atomic weapons. It is hoped also to obtain by the work at this new experimental station a broader understanding of the phenomena of nuclear fission, such as will lead to further advances in the peaceful applications of atomic energy.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE ENGINEERS' GERMAN CIRCLE

Sir,—It is a matter of considerable regret to me that according to the letter published in the issue of The Engineer for December 12th, "The Committee" should have decided to wind up "The Engineers' German Circle" without having first endeavoured to consult members on this decision either by circular letter or by announcement in the technical press.

I take leave to doubt the statement "that there is little prospect of reviving the activities of the Circle," because when I attended the International Congress for Engineering Education at Darmstadt, this summer, I found that one of the largest foreign delegations consisted of participants from this country, who had been sufficiently interested to overcome the considerable administrative and other difficulties involved in making a journey to Germany under present circumstances.

Moreover, in view of the very limited possibilities for foreign travel and study now available, I should have thought that "The Engineers' German Circle" was actually meeting a real need. In this connection the article by Mr. C. L. Champion on "The Training and Work of the Swiss Engineer" and the note on the meeting at Montreal on "Standard Engineering Courses" also published in the same issue, taken together with the subjects covered by the Darmstadt Congress at an international level, would seem to indicate a general stirring among engineers the world over to revise their present outlook and the course of studies on which it is based and also to learn something of "the other fellow's" opinion on the problems that have to be faced by our generation.

As regards the possible lack of suitable lecturers, I should imagine that Austrian and Swiss engineers, not to mention a D.P., or even a P.O.W., would be only too pleased to step in the breach.

C. Carty.

London, W.C.1, December 17, 1947.

ENGINEERS' SALARIES

Sir,—Human affairs, as the schoolgirl said, are often upset when "sex rears its ugly head." This, Sir, never happens in your lustrous pages. The reason for this, of course, is that engineers are people of a special kind. But we have our monster, which every now and again "rears its ugly head" at our feast. Its name is Engineering Salaries, and it is commonly evoked by three words, to be pronounced from within the confines of the "Situations Vacant" column, "State salary required."

An issue of late 1946 contained thirty-three advertisements which included these words. Your issue of December 19th contained only seventeen. This indicates a growing sense of responsibility in this matter.

More encouraging still is the announcement in the same issue of the salary scales suggested by the Association of Scientific Workers. The Association is to be congratulated on a much-needed piece of work, giving guidance which was often vainly sought in the past. It is to be hoped that engineers will avail themselves of these scales to a sufficient extent to assure that they will receive the "universal recognition" sought by the Association. As a member, I am informed that copies may be obtained from the head office at 15, Half Moon Street, London, W.1.

A. M. Conybeare.

London, W.5, December 22nd.

Industrial and Labour Notes

The T.U.C. Committee on the Economic Situation

The Trades Union Congress has now issued the interim report of its committee, which is investigating various aspects of the present economic situation. The report is to be considered by the executive councils of affiliated unions and in due course the General Council of the T.U.C. will circulate a full and final statement dealing with the inter-related problems of prices, subsidies, profits and wages, all of which matters the special committee has under examination. As has been announced already, it is intended to call a conference of trade union executives when this final report is completed.

The present document comments on the rising cost of subsidies and then proceeds to discuss briefly the *rôle* of trade unions under present conditions. It says that no one will deny the unions and the T.U.C. a special and particular right to views upon the continuation of cost-of-living subsidies. Workpeople seldom make the mistake of thinking that trade unions should confine themselves to participation in the determination of weekly wages and actual working conditions, and—particularly in periods of far-reaching economic developments and adjustments—the efforts of trade unions to maintain the standards of living of workpeople would fail completely if they were limited to attempts simply to adjust weekly wages to constantly increasing prices. The machinery of industrial negotiation, and the negotiators themselves, function most effectively, the report comments, in conditions of reasonable industrial and economic stability and in the absence of frequent and violent fluctuations in prices.

The assertion is therefore made in the report that, by experience as well as by interest, trade unions are fully qualified to express opinions on the cost-of-living subsidies. It is pointed out that the T.U.C. was compelled in the early days of the recent war to consider and to advise the Government on the policy to be pursued during the period in which goods for domestic consumption were certain to be restricted and costs bound to increase.

Voluntary Collective Bargaining

Another section of the T.U.C.'s statement deals with voluntary collective bargaining, and begins by observing that in the early days of the war there were, as there are now, suggestions that a situation of limited supplies and rising costs could best be met by the imposition of direct restrictions upon wage increases. To those suggestions and to others similarly directed towards controlling the pressure on prices by restricting the volume of money, the T.U.C. says that it has given most careful consideration, but in the light of its experience it has remained throughout firmly convinced that it is impracticable, and would in any case be undesirable to impose specific limits and restrictions on wage increases. Furthermore, the T.U.C. feels that it would be equally unwise and impracticable to establish any external body as an authority capable of determining the movement and adjustment of the wage rates of the millions of wage earners who, even when circumstances were less favourable to them, have always accepted the full implications and the consequences of voluntary collective bargaining.

On this matter the report adds that the T.U.C. has always advised successive Governments to concentrate their efforts on creating conditions, which, whilst allowing the two sides of industry freely to negotiate and arrive at wage agreements, give also encouragement to proceed with caution and restraint. On the problem of inflation, the T.U.C. says that it has advocated the adoption of measures designed to hold down the prices of essential commodities, to restrict the competition for scarce essential commodities, and to restrain by taxation and the encouragement of voluntary savings, the pressure of money on the prices of those scarce commodities which it is admittedly difficult to control. To the extent that the Government is able by those means, reinforced by Exchequer subsidies, to preserve stability in the price level, to that extent it is asserted, an indirect but most effective contribution to price stability is made by removing from all persons—workpeople included—the spur and indeed the necessity to endeavour to maintain their standards of living by means of regular and substantial increases in their monetary incomes.

The T.U.C. believes that the Government should continue the practice of cost-of-living subsidies as one of the means of ensuring price stability. The report comments that the Government on its part is encouraged and assisted in its own direct efforts to maintain price stability by the recognition by individual trade unions of the part they can play in accepting the obligation to continue to use their considerable power and authority in wage negotiations with a full sense of their responsibilities to their own members and to the nation as a whole.

The Need for Greater Output

The final paragraphs of the T.U.C. interim statement are devoted mainly to stressing once again the need for a substantial and sustained increase in industrial production. It is pointed out that increased production, particularly of commodities which can be sold in foreign markets and specifically in the scarce currency areas, is the greatest possible contribution that can be made in reducing the pressure of inflationary tendencies which threaten to lessen the purchasing power of current wages, salaries and income generally. Without a sufficient increase in output and a large-scale expansion of exports, it will be impossible to keep prices on a stable level.

In conclusion, the report says that the T.U.C. General Council is giving detailed consideration to the methods by which, and the extent to which, the control of prices and profits can be developed. In the meantime a strong appeal is made to all workpeople and to trade unionists particularly to do their utmost by individual and collective effort to increase production in every possible way. An urgent appeal is also made to trade union executives to continue to maintain by wise leadership their authority in the exercising of their responsibilities, and to pay constant regard to the economic difficulties of the country at the present time.

Ordnance Factory Workers' Wage Claim

It is reported that an application for an all-round increase of 22s. a week in the wages of engineering workers in Royal Ordnance Factories and other Government industrial plants is to be made by the Engineering Trades Joint Council for Government Departments. About 60,000 workers are involved in this claim, which, it is understood, will be on the basis of another 6d. an hour for both skilled and unskilled grades.

The Coal Mining Industry

At a Press conference in London last week, Lord Hyndley reviewed the activities of the National Coal Board during the first year of its existence. In addition to surveying the progress made in mine mechanisation, improving the quality of coal, marketing, research and education, Lord Hyndley dealt in some detail with the subject of manpower and also discussed coal output trends.

At the beginning of 1947, the number of men employed in the British coal mining industry was 692,000, but as a result of an intensive recruiting drive and the introduction of shorter working hours, Lord Hyndley said that that number rose steadily during the first seven months of the year, until in July a peak figure of 719,250 was reached. At that time it looked as if the year's manpower target of 730,000 might be achieved, provided that wastage did not rise above 1200 a week and intake rate of 1800 a week was maintained. Wastage in the later months of the year had, however, exceeded expectations, and although the recruits had been obtained, the expected manpower goal would not be reached in spite of a slight improvement in recent weeks.

For 1948, Lord Hyndley continued, the Board had set a manpower target of 750,000. Of that number 740,000 would be needed and could be employed in the business of coal-getting and over 305,000 would be working at the coal face, an increase of nearly 12,000 on last year's number of faceworkers. The remaining 10,000 would be required for the major reconstruction projects on which the Board would be making a start during the year. Assuming that the rate of wastage remained fairly constant throughout 1948, Lord Hyndley said that at least 70,000 recruits would be needed if the net increase of 30,000 required to reach the target was to be attained.

Reviewing generally the year's coal production, Lord Hyndley said that while the 1947 target of 200,000,000 tons could only be achieved—if then—by including the results of a fifty-third week, there had nevertheless been a substantial increase over 1946. In the period during which a five-day week had been in operation, approximately twenty-five Saturday shifts had been lost. The increased output for the year, however, had been achieved in spite of that, partly by higher output per manshift—which, in respect of faceworkers, had risen from an average of 2·76 tons in 1946 to nearly 3 tons by the end of 1947—and partly by a reduction in absenteeism, the 1946 figure for which had averaged 19·32 per cent at the face, compared with round about 13 per cent in recent weeks. Actually, output per manshift at the face was now above the pre-war figure, Lord Hyndley stated, but absenteeism had to be reduced still further to pre-war standards before the output per worker per year would be comparable.

Marketing and the Export Drive

Shortly before Christmas, a joint deputation representing the National General Export Merchants' Group and the Import and Export Merchants' Section of the London Chamber of Commerce discussed with the President of the Board of Trade the importance of marketing to the export drive.

The deputation claimed that about three-quarters of this country's export trade before the war was done by or through merchants, and urged that selling was not the job of a manufacturer, as the organisation, knowledge and attitude of mind required for successful marketing were not the same as those needed for efficient manufacture. By selling through export merchants, the deputation asserted, manufacturers were relieved of anxiety over various terms and conditions of payment and credit upon which goods were shipped, and over regulations with which it was necessary to comply both here and overseas. British merchants had their own establishments and their own connections throughout the world, which, the deputation suggested, constituted a great national asset that should be fully utilised and encouraged by the Government.

The President of the Board of Trade assured the deputation that he and his officials were fully aware of the services rendered to the country by the reliable export merchants, and appreciated the assistance given to manufacturers in their endeavours to sell abroad. The Government realised its responsibility to secure removal or at least modification of the import restrictions imposed by overseas countries and this was a primary purpose in all bilateral negotiations. Finally, the President expressed the hope that the Export Merchants' Group would continue to maintain close contact with the Board of Trade and arrange to bring to his notice, as they arose, matters of policy affecting export.

French Engineering News

(From our French Correspondent)

PARIS, December 26th

Repercussions due to the rise in the price of coal will probably lead to a revaluation of all industrial prices, but this has not yet been fixed. It will particularly be true in the steel industry which will also have to take a rise in transport and electricity costs into consideration. This will mean a further shrinking in France's export chances.

* * *

The Société Keller-Leleux has had eight electric ovens working this year compared with only four in 1946. The Société, whose electric installations were transferred to Electricité de France, is attempting to have the decree of transfer annulled, since most of the single-phase current produced is not used outside the factories.

* * *

Production of sheet metal is still largely below demand. Using new equipment, the Port-du-Rhin factories of the Forges de Strasbourg have produced in September and October, 1947, over 6000 tons each month, against a monthly average of 1900 tons a month pre-war and 2600 tons in 1946. The Koenigshoffen factory is producing 500 tons a month against the pre-war maximum of 300 tons, and even higher output is envisaged for the future, reaching a monthly average of 800 tons.

* * *

At the Forges et Ateliers de Constructions Electriques de Jeumont, where difficulties of power, supplies and labour have held up output, the introduction of new machine tools has raised output for the first eight months of 1947 to equal that for the whole of 1946. There has been an increase in personnel amounting to 500 new workers.

* * *

The Ministry of Industry has given some information relating to the continued shortage of electric light bulbs. The total quantity produced during the first half of 1947 was 36 million bulbs; for the third quarter of 1947 production dropped owing to strikes and paid holidays, but production for the fourth quarter is expected to be 18 million bulbs, so that the total for the year will be about 55 to 56 millions. Out of this total, 35 to 40 per cent are absorbed by public services and priority users, such as the S.N.C.F., Electricité de France, and the mines, and 60 per cent are delivered by manufacturers or wholesalers to non-priority consumers. The present level of production in France is about the same as that of 1938. Shortage of lamps is due to the fact that stocks have never been built up following wartime deficiencies and because the quality is far inferior to pre-war.

* * *

War damage to the French armaments industry has been summarised as follows: artillery material production potential has been reduced by two-thirds; artillery ammunition by one-third; bomb production potential is practically nil; all the great filling workshops have been destroyed; pyrotechnics production has been reduced by three-quarters, and small arms by one-third. Damage has been so extensive that at the moment it is not possible to foresee complete restoration, and the reconstruction programme will start by using salvaged material for equipping plant to manufacture supplies indispensable to the functioning of the services. The programme is expected to cost 2000 million francs in 1948.

* * *

The electrification of the Paris-Lyons line will involve the construction of numerous buildings, covering a total area of 82,000 square metres. The choice of sites for sub-stations does not present any particular problem except for that of Samoreau, where, in conformity with town-planning requirements, the site originally planned for the platform of the sub-station has been lowered by one metre. On the Paris-Lyons line fifty-one sub-stations will be constructed.

Notes and Memoranda

Rail and Road

LONDON TRANSPORT'S FROST PREPARATIONS.—Special preparations based on experience gained in last year's severe winter have been made by London Transport to keep buses running if Arctic conditions should develop. A total of 7500 radiator covers and radiator blinds, doubling existing stocks, have been purchased. Arrangements have been made to use anti-freeze liquid on a large scale in bus radiators for the first time, and 6000 gallons of liquid have been stocked. For the first time, supplies of glycerine have been sent to all garages to smear on windscreen wiper blades and other exposed parts to prevent them freezing up, while stocks of anti-mist compound have been provided for the windscreens of buses and coaches in specially snowy areas, such as the North Downs. Thirty thousand gallons of specially light winter-grade oil are to be used in an experiment on one bus in eight to see if it aids cold weather running. Pipes on buses, trolleybuses and coaches which last year were found to be specially vulnerable in extreme cold, have been protected by the use of 31 miles of asbestos lagging. Emergency alternative routes by-passing hills which last year became impassable to traffic after heavy snows have also been worked out in advance.

FUEL OIL FOR ROAD VEHICLES.—The Minister of Fuel and Power has approved the introduction by the Petroleum Board of a new price schedule for diesel fuel oil for road vehicles. The new price schedule reintroduces the normal peacetime system of zonal prices based on distance from the importing centre. It also incorporates revised quantity rebates, which eliminate wartime difference in the treatment of old and new consumers. The Petroleum Board, therefore, with the approval of the Ministry of Fuel and Power, has now reverted to the zonal method of pricing which was a feature of the pre-war system and which has already been reintroduced for diesel oil used otherwise than for motor vehicles, as well as for all fuel oils and kerosenes. Under the new scheme the Board's basic prices for bulk delivery in lots of 500 gallons or more are now as follows: inner zone, 1s. 6¾d. a gallon; outer zone, 1s. 7d. a gallon; and general zone, 1s. 7¼d. a gallon. The general zone price corresponds with the previous standard schedule price in all these zones. The Petroleum Board is also granting quantity rebates to every customer taking more than 25,000 gallons a year of diesel fuel oil for use in road vehicles, at a rate varying from ¼d. a gallon on 25,000 to 50,000 gallons, to ¾d. a gallon on deliveries exceeding 1,000,000 gallons a year.

Air and Water

AUSTRALIA'S ANTARCTIC EXPEDITION.—One "Walrus" and two Sikorski "Kingfisher" aircraft are undergoing modifications necessary for operation in polar conditions during Australia's Antarctic expedition. According to *Australian Aviation Newsletter*, the "Walrus" will be used on the fleet auxiliary vessel which will take ground parties to both Macquarie Island, south-east of Tasmania, and Heard Island, south-west of Perth, Western Australia. One of the "Kingfishers" will operate from the "Wyatt Earp," which is to undertake a systematic reconnaissance of the coast of the Australian Antarctic territory. The remaining "Kingfisher" will be held in reserve.

LARGE AIR FREIGHT CONSIGNMENT.—There has been completed recently what is claimed to be the largest single consignment of air express freight ever to be carried in Australia. Sixty tons of mill machinery were sent by Austral Bronze Company Pty., Ltd., of Alexandria, New South Wales, to the firm's annexe in Hobart, Tasmania. The freighting took place in three phases and was covered in seven trips. The move was made as part of a plan to develop the brass and copper strip industry in Tasmania. The annexe taken over in the Derwent Valley, Hobart, allows for immediate expansion, and it is stated that transport of the equipment by air ensured minimum dislocation of output.

Miscellanea

NON-FERROUS SEMI-MANUFACTURED MATERIAL.—The Ministry of Supply announces that from January 1, 1948, its stocks of non-ferrous semi-manufactured material will be disposed of in bulk lots from time to time by competitive tendering. Any firm wishing to tender for this class of store and not already on the list of firms eligible to be invited should apply to the Directorate of Disposals/N.F.M., Room 354, Great Westminster House, Horseferry Road, London, S.W.1. The National Stock List of Ministry-owned non-ferrous semi-manufactures will no longer be issued.

FUEL ECONOMY IN BOILER PLANTS.—A written reply by the Parliamentary Secretary to the Ministry of Fuel and Power states that twenty-five specialist officers of the Ministry are fully employed visiting industrial firms to instruct boiler-house operatives in efficient and fuel-saving methods of stoking and control of boiler plant. In addition, fifty-three comprehensive courses in boiler-house practice are in progress at technical colleges.

ZINC ALLOY GEARS.—Some notes on the commercial applications of zinc alloy gears have been prepared and published recently by the Zinc Alloy Die Casters Association. The notes are addressed primarily to engineers and direct attention, amongst other matters, to the advantages of modern pressure die casting in the quantity production of gears. They include also some comments on the necessary specifications for zinc alloy and some advice on lubrication. Copies of the notes can be obtained from the Association, Lincoln House, Turl Street, Oxford.

I.E.E. BENEVOLENT FUND.—The President of the Institution of Electrical Engineers, Mr. Percy Good, has addressed to all members a special appeal concerning the Institution's Benevolent Fund. It will be recalled that a site of 8 acres at New Malden, Surrey, has been presented to the Institution, and it is intended to utilise this for building houses which will accommodate members of the Institution who have been financially unfortunate. The sum of £50,000 is required for development of the site and for providing suitable accommodation, and in his appeal the President has given special emphasis to the desirability of raising this sum as quickly as possible as a memorial to those who fell in the war.

ELSWICK, 1847–1947.—The Elswick Works, Newcastle-upon-Tyne, of Vickers-Armstrongs, Ltd., were founded by William Armstrong in 1847, and to mark the centenary the firm has produced a well-illustrated brochure which surveys the development of Elswick during the last hundred years. It includes a character sketch of the distinguished founder, a review of ordnance and other activity in wars dating from the Crimea, accounts of amalgamation first in 1897 with Sir Joseph Whitworth and Co., and later in 1928 with Vickers, Ltd. Mention is also made of the many and varied products of Elswick in days past and at the present time. A review of "the years and their changes," towards the end of the brochure, recalls the working habits and conditions of Elswick's early years. It tells, for instance, how the old hands, entering the engine works time office to "draw their boards," filed first through the "Hydraulic Crane," where the doors opened as the buzzer began to sound at six o'clock. Each had a hot whisky for a penny and dropped the glass in a sawdust bin as he went out; and he drew his board before the buzzer stopped.

Calendars and Diaries

WE acknowledge receipt of calendars and/or diaries for 1948 from the undermentioned firms:

K.L.M., Royal Dutch Airlines.

A. C. WICKMAN, Ltd., Coventry.

BRITISH ROPES, Ltd., Doncaster.

RUSTON-BUCYRUS, Ltd., Lincoln.

HOLMAN BROTHERS, Ltd., Camborne.

FERRANTI, Ltd., Hollinwood, Lancashire.

D. NAPIER AND SON, Ltd., London, W.3.

G. AND T. EARLE, Ltd., Wilmington, Hull.

DAVEY, PAXMAN AND CO., Ltd., Colchester.

MACROME, Ltd., Aldersley, Wolverhampton.

BUTTERS BROTHERS AND CO., Ltd., Glasgow.

GEAR GRINDING COMPANY, Ltd., Birmingham.

G.P.U., Ltd., 56, Victoria Street, London, S.W.1.

J. SAMUEL WHITE AND CO., Ltd., Cowes, Isle of Wight.

D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.

ASHWELL AND NESBIT, Ltd., Barkby Lane, Leicester.

JOHN H. RIDDEL, Ltd., 62, Robertson Street, Glasgow. C.2.

BRITISH INSULATED CALLENDER'S CABLES, Ltd., Prescot.

ASSOCIATED EQUIPMENT COMPANY, Ltd., Southall, Middlesex.

BRITISH TIMKEN, Ltd., Cheston Road, Aston, Birmingham, 7.

EDWARD WOOD AND CO., Ltd., 68, Victoria Street, London, S.W.1.

LONDEX, Ltd., Anerley Works, 207, Anerley Road, London, S.E.20.

MACKAY INDUSTRIAL EQUIPMENT, Ltd., Faggs Road, Feltham, Middlesex.

ESCHER WYSS ENGINEERING WORKS, Ltd., 52, Grosvenor Gardens, S.W.1.

HALL HARDING, Ltd., Stourton House, Dacre Street, Westminster, London, S.W.1.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

To-day, Jan. 2nd.—YORK BRANCH: Royal Station Hotel, York. "Electronics in the Control of Industrial Equipment," F. E. Noakes. 7.30 p.m.

Tuesday, Jan. 6th.—SOUTH-EAST LONDON BRANCH: Castle Hotel, High Street, Eltham. "Maintenance Records," Mr. Le Sueur. 8 p.m.—WEST LONDON BRANCH: Oddfellows' Hall, 186, Hammersmith Road, W.6. "Candid Comments on the Question of Propaganda in relation to Illuminations," G. V. Downer. 7 p.m.

Wednesday, Jan. 7th.—NORTH LONDON BRANCH: Three Jolly Butchers Hotel, Wood Green, N.22. "High-Frequency Treatment in Industry," E. G. Auty. 8 p.m.—NORTH-EAST LONDON BRANCH: Mawney's Arms, Mawney's Road, Romford. "Electronics," J. Jackson. 8 p.m.

Thursday, Jan. 8th.—ST. ALBANS BRANCH: The Peahen Hotel, London Road, St. Albans. "Resistance Welding," H. E. J. Butler. 7.15 p.m.

Friday, Jan. 9th.—LIVERPOOL BRANCH: Electric Supply Company Showrooms, Whitechapel, Liverpool. "Light and Colour," Mr. Ablett. 6 p.m.

British Interplanetary Society

Wednesday, Jan. 7th.—St. Martin's Technical School, 107, Charing Cross Road, W.C.2. "The Man-Carrying Rocket," R. A. Smith. 6.30 p.m.

Chemical Society

Thursday, Jan. 8th.—Burlington House, Piccadilly, W.1. "Structural Relationships in the Natural Unsaturated Higher Fatty Acids," T. P. Hilditch. 7.30 p.m.

Diesel Engine Users Association

Thursday, Jan. 15th.—Caxton Hall, Caxton Street, S.W.1. "Porous Chrome Hardening of Diesel Engine Cylinders," C. D. B. Williams. 2.30 p.m.

Illuminating Engineering Society

Friday, Jan. 9th.—Imperial Hotel, Temple Street, Birmingham. Annual dinner. 6 p.m.

Incorporated Plant Engineers

Thursday, Jan. 8th.—NEWCASTLE-UPON-TYNE BRANCH: Y.M.C.A., Connaught Rooms, Blackett Street, Newcastle-upon-Tyne. Annual general meeting 7.30 p.m.—PETERBOROUGH BRANCH: Grand Hotel, Peterborough. Annual general meeting. 7.30 p.m.

Friday, Jan. 9th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham. Annual general meeting. 7.30 p.m.

Institute of British Foundrymen

Wednesday, Jan. 7th.—Engineers' Club, Albert Square, Manchester. "Centrifugally and Precision Cast Ferrous Alloys for Aircraft Applications," J. F. B. Jackson. 7 p.m.

Saturday, Jan. 10th.—NEWCASTLE BRANCH: Neville Hall, Newcastle-upon-Tyne. Past-President's night. 6 p.m.—SCOTTISH BRANCH: Royal Technical College, George Street, Glasgow. "Mechanised Bath Production," R. S. M. Jeffrey. 3 p.m.

Monday, Jan. 12th.—SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield. "The Use of Fulbond in Foundries," L. Roy. 7.30 p.m.

Institute of Economic Engineering

Saturday, Jan. 3rd.—Chamber of Commerce, Birmingham. "Time and Motion Study in the Foundry," C. D. Pollard. 2.30 p.m.

Institute of Marine Engineers

Tuesday, Jan. 13th.—85, Minories, E.C.3. "Sea Water Contamination of Boiler Fuel Oil and its Effects," C. J. Gray and W. Killner. 5.30 p.m.

Institute of Metals

Thursday, Jan. 8th.—4, Grosvenor Gardens, S.W.1. "Silver," L. B. Hunt. 7 p.m.

Institute of Petroleum

Wednesday, Jan. 14th.—Manson House, 26, Portland Place, W.1. "Polythene," J. C. Swallow. 5.30 p.m.

Institute of Road Transport Engineers

To-day, Jan. 2nd.—Ca'doro Restaurant, Glasgow. Annual dinner-dance of the Scottish Centre.

Institute of Transport

To-day, Jan. 2nd.—WESTERN SECTION: Port of Bristol Authority, Bristol. "The Transport Act," T. D. Corpe. 1.15 p.m.—LEEDS GRADUATES: City Transport Department, Leeds. "The White-Collar Worker in Road Transport," W. R. Lang. 7 p.m.

Institution of Chemical Engineers

Tuesday, Jan. 13th.—Burlington House, Piccadilly, W.1. "Detergency," B. Edgington. 5.30 p.m.

Institution of Civil Engineers

Tuesday, Jan. 6th.—Great George Street, S.W.1. "Airfield Lighting," Clifford Heyes and J. Brierley. 5.30 p.m.—NEWCASTLE-UPON-TYNE ASSOCIATION: Student Meeting. North of England Institute of Mining and Mechanical Engineers, Westgate Road, Newcastle-upon-Tyne. "Modern Strain Gauge Techniques," W. B. Dobie. 6.15 p.m.—SOUTH WALES ASSOCIATION: South Wales Institute of Engineers, Park Place, Cardiff. "Present Day Tendencies in the Design and Construction of Concrete Roads," W. P. Andrews. 6 p.m.

Thursday, Jan. 8th.—Engineers' Club, Albert Square, Manchester. "Roads and Their Riding Qualities," W. J. O. Scott. 6.30 p.m.

Institution of Electrical Engineers

Monday, Jan. 5th.—SOUTH MIDLAND CENTRE: James Watt Memorial Institute, Great Charles Street, Birmingham. "Comparison Between Gas and Electricity on the Basis of Coal Economy," P. Schiller. 6 p.m.

Monday, Jan. 12th.—NORTH-EASTERN CENTRE: Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Comparison Between Gas and Electricity on the Basis of Coal Economy," P. Schiller. 6.15 p.m.—LONDON STUDENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Place of the Engineer in the Postwar World," Sir Arthur Fleming. 7 p.m.

Tuesday, Jan. 13th.—NORTH MIDLAND CENTRE: Corporation Electricity Department, Whitehall Road Leeds. "Neutral Earthing of Three-phase Systems, with Particular Reference to Large Power Stations," J. R. Mortlock and E. M. Dobson. 6.30 p.m.

Institution of Heating and Ventilating Engineers

Wednesday, Jan. 7th.—Institution of Civil Engineers, Great George Street, S.W.1. "Comfort Cooling in the Tropics," J. F. L. Grocott, A. R. T. C. Salf, and M. Amer. 6 p.m.—EAST MIDLANDS BRANCH: College of Technology, The Newarke, Leicester. "The Objects and Limitations of Water Treatment," W. Murray. 6.30 p.m.

Monday, Jan. 12th.—MANCHESTER AND DISTRICT BRANCH: Milton Hall, Deansgate, Manchester. "Air Conditioning Plant for Cotton Mills," A. Leslie Longworth. 7 p.m.

Institution of Mechanical Engineers

To-day, Jan. 2nd.—Storey's Gate, St. James's Park, S.W.1. "Modern Cutting Tools and Machine Tool Design," C. Eatough. 5.30 p.m.

Tuesday, Jan. 6th.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, S.W.1. Chairman's Address, G. T. Smith-Clarke. 6 p.m.

Friday, Jan. 9th.—Storey's Gate, St. James's Park, S.W.1. "The Design of Contra-Flow Heat Exchangers," Ernst Schmidt. 5.30 p.m.

Institution of Post Office Electrical Engineers

Tuesday, Jan. 6th.—Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. "The Location of Faults in Lines and Cables," A. C. Timmis. 5 p.m.

Institution of Production Engineers

Saturday, Jan. 3rd.—WOLVERHAMPTON GRADUATE SECTION: Visit to Messrs. Stewart and Lloyds, Bilston. 9.30 a.m.

Monday, Jan. 5th.—YORKSHIRE SECTION: Hotel Metropole, Leeds. "Ball and Roller Bearings," F. Hickling. 7 p.m.

Wednesday, Jan. 7th.—PRESTON SECTION: Harris Institution, Corporation Street, Preston. "Induction Heating." Representative of Philips Lamps, Ltd. 7.15 p.m.

Monday, Jan. 12th.—HALIFAX SECTION: White Swan Hotel, Halifax. "Britain's Industrial Future," Lewis C. Ord. 7 p.m.—LUTON AND DISTRICT SECTION: Town Hall, Luton. "Press Work," Mr. Grainger. 7 p.m.—DERBY SUB-SECTION: Art School, Green Lane, Derby. "Making a Typewriter," R. M. Evans. 6.45 p.m.

Institution of the Rubber Industry

Friday, Jan. 9th.—Bell Hotel, Humbertsone Gate, Leicester. "Libraries and the Handling of Technical Information in the Rubber Industry," G. A. Shires. 7.30 p.m.

Monday, Jan. 12th.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Man-Made Fibres in Tyre Castings," J. W. Illingworth. 7.15 p.m.

Institution of Structural Engineers

Tuesday, Jan. 6th.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. "Recent Trends in Structural Welding."

Thursday, Jan. 8th.—11, Upper Belgrave Street, S.W.1. "Some Aspects of the Supervision of Civil Engineering and Building Contracts in Wartime," E. H. Macmillen. 5.55 p.m.

Junior Institution of Engineers

To-day, Jan. 2nd.—39, Victoria Street, S.W.1. Informal Meeting: Films. 6.30 p.m.

Friday, Jan. 9th.—39, Victoria Street, S.W.1. "Gas Turbine Power Plants for Aircraft Propulsion," R. M. Cracknell. 6.30 p.m.

Keighley Association of Engineers

Friday, Jan. 9th.—Devonshire Buildings, Devonshire Street, Keighley. "Diesel Engines," J. Whitaker. 7.30 p.m.

Manchester Association of Engineers

Friday, Jan. 9th.—College of Technology, Sackville Street, Manchester. "Researches now in Progress in the Cavendish Laboratory," Sir Lawrence Bragg. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Jan. 9th.—Mining Institute, Newcastle-upon-Tyne. "Design of Marine Heating and Ventilating Systems in Accommodation," R. McDonald. 6.15 p.m.

Royal Institution of Chartered Surveyors

Monday, Jan. 5th.—12, Great George Street, S.W.1. "The Evolution of a New Town," Sir Thomas Bennett. 5.30 p.m.

Women's Engineering Society

Tuesday, Jan. 6th.—LONDON BRANCH: 35, Grosvenor Place, S.W.1. Twelfth Night Social. 7 p.m.

Saturday, Jan. 10th.—MANCHESTER BRANCH: Visit to Fowlers (Calculators), Ltd. 2.30 p.m.

Personal and Business

MR. C. J. LAKE has been appointed chairman of Lake and Elliot, Ltd.

MR. W. B. BAXTER has been appointed a director of the United Steel Companies, Ltd.

MR. G. H. SHELDON has been appointed managing director of Walker Bros. (Wigan), Ltd.

MR. E. H. O. ELKINGTON has been appointed a director of the Anglo-Iranian Oil Company, Ltd.

MR. GODFREY OAKEY and Mr. J. Graham Oakey have been elected directors of John Oakey and Sons, Ltd.

MR. G. W. GRIFFIN, general works manager, has been appointed to the board of Siemens Brothers and Co., Ltd.

MR. R. M. T. RICHARDS has been appointed Deputy Chief Regional Officer, British Railways, Southern Region.

MR. H. V. REDSHAW has been appointed managing director of the Crane Foundry Company, Ltd., Wolverhampton.

LITHART PRODUCTS states that its address is now Chantry Bridge End, Wakefield (telephone, Wakefield 2400).

MR. PATRICK G. MURPHY has been appointed chief engineer in charge of all the technical departments of the Electricity Supply Board, Eire.

MR. OLIVER MIDGLEY TAYLOR, M.A., A.M.I.C.E., has become a partner in the firm of John Taylor and Sons, chartered civil engineers, Artillery House, Artillery Row, S.W.1.

PHILIPS ELECTRICAL INDUSTRIES, Ltd., has been formed as a holding company with a capital of £2,500,000 to acquire and hold certain shares of the Philips Group of Companies in Great Britain.

MR. M. HARTLAND THOMAS has joined the Council of Industrial Design to take charge of its Industrial Section, which is directly concerned with offering a practical service to industry on design problems.

THE BRITISH ALUMINIUM COMPANY, Ltd., announces the retirement, after forty years' service, of Mr. H. Cousins, publicity manager. The firm's publicity department has now been combined with the sales, research and statistical section under Mr. C. G. McAuliffe. Mr. E. G. Fielding has been appointed publicity officer.

Reports on German and Japanese Industry

Limited numbers of copies of the reports of Intelligence Objectives Sub-Committees on German and Japanese Industry listed below can be obtained from H.M. Stationery Office at the prices stated.

No. of report.	Title.	Post free. s. d.
F.I.A.T.:		
1077	The Manufacture of Phenol Formaldehyde Resins and Moulding Powders	6 8
1081	Manufacture of Diethylamine from Acetaldehyde, I.G. Farbenindustrie A.G., Ludwigshafen	2 2
1091	(I) Asphalt Lining of Canals and Storage Basins; (II) Asphalt Lining of Vertical Walls, Report in German with English Translation	7 2
1110	The Production and Use of Polyvinyl Alcohol	1 7
1146	Preparation of Rochelle Salt Crystals	1 1
J.I.O.A.:		
49	Some Documents and Catalogues of German Coal-fired Heating and Cooking Stoves Manufactured During or Just Before the War	2 2
B.I.O.S:		
Misc. 38 ...	Chocolate-Kola Formulæ and Manufacturing Process, Schoko Buck G.m.b.H., Stuttgart ...	1 1
JAP/P.R./887	Japanese Use of High-Temperature Alloys in Rocket, Jet and Gas Turbine Applications... ...	1 1
Classified List No. 8: Consolidated List Under Subject Headings of all Reports on German and Japanese Industry Published up to and Including May 31, 1947		1 3
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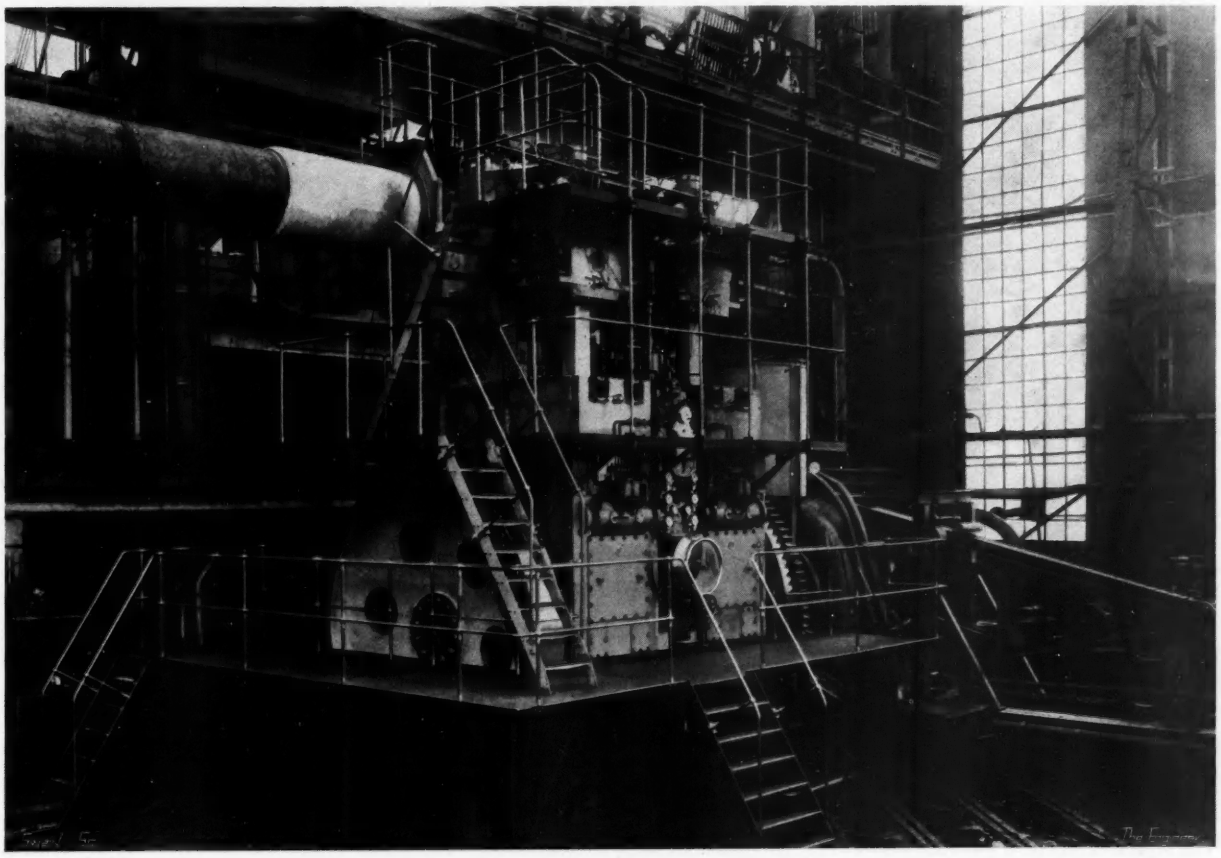
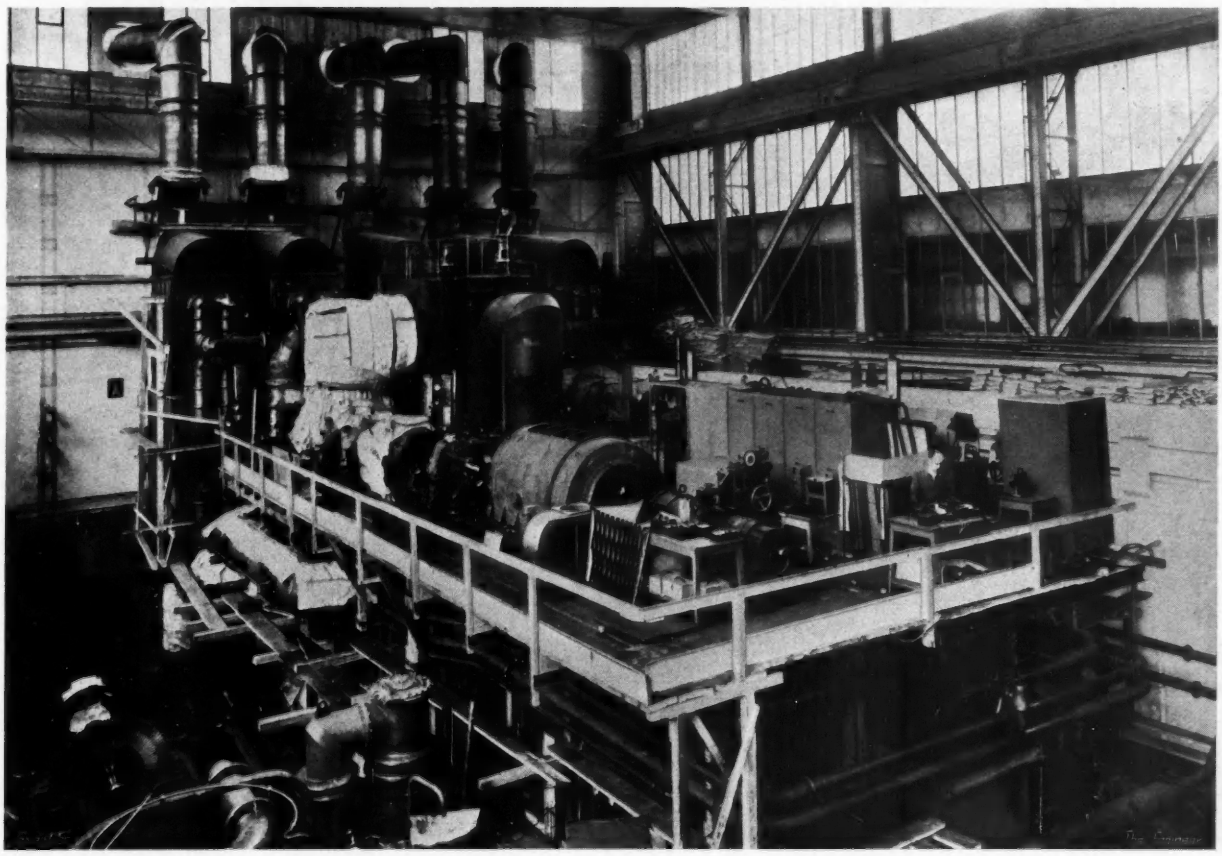
Technical Information and Documents Unit, German Division, Board of Trade, 40, Cadogan Square, S.W.1, which has at its disposal a considerable volume of information not in a form suitable for general reproduction, is prepared to receive enquiries regarding all problems relating to scientific and technical intelligence on both German and Japanese industry.

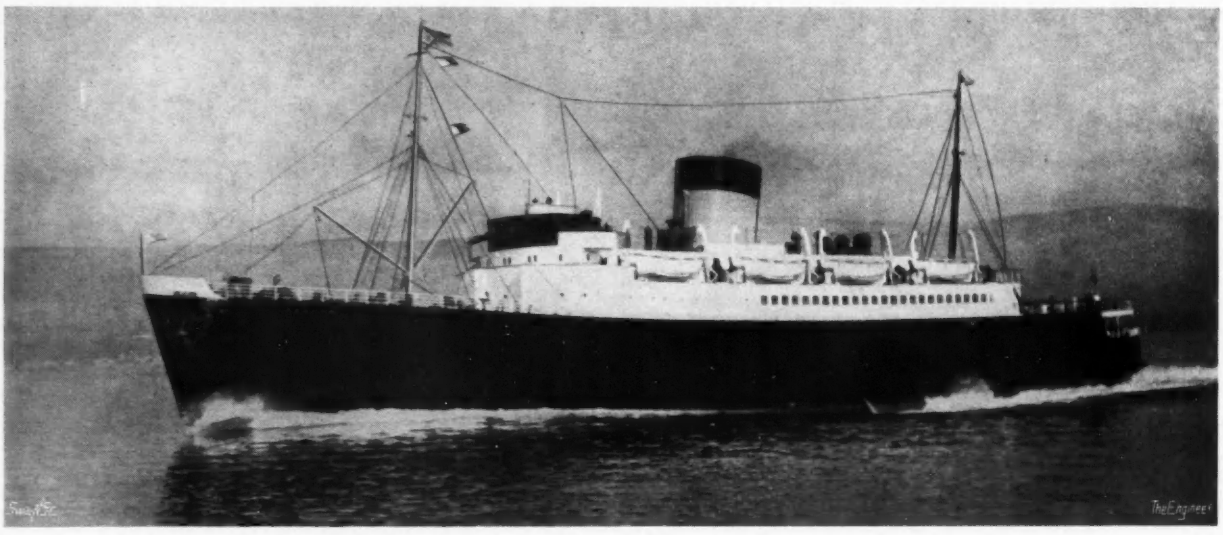
PRIME MOVERS OF 1947

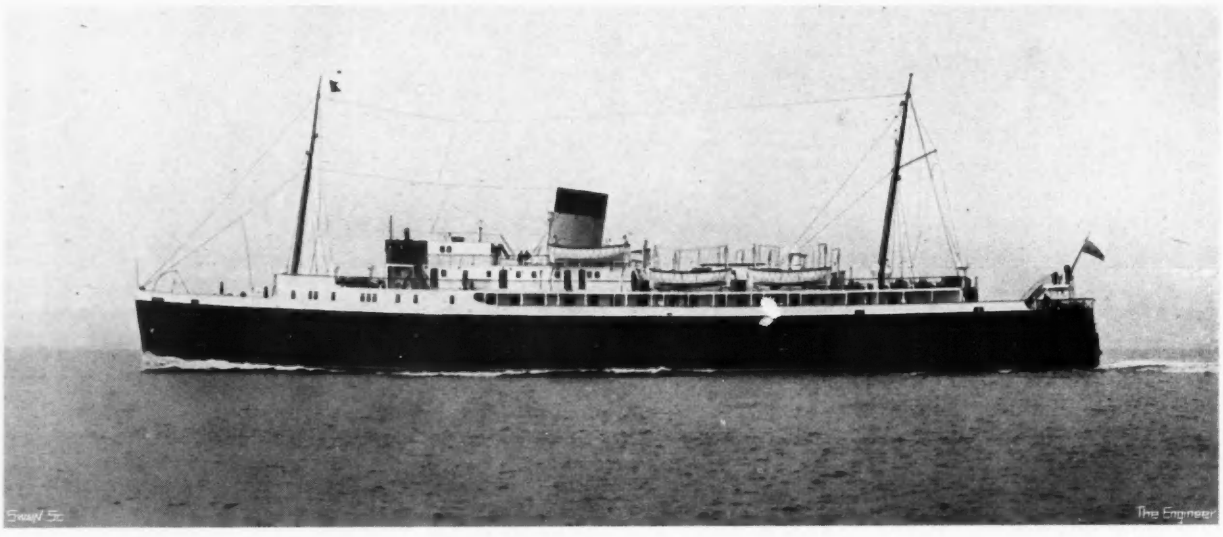


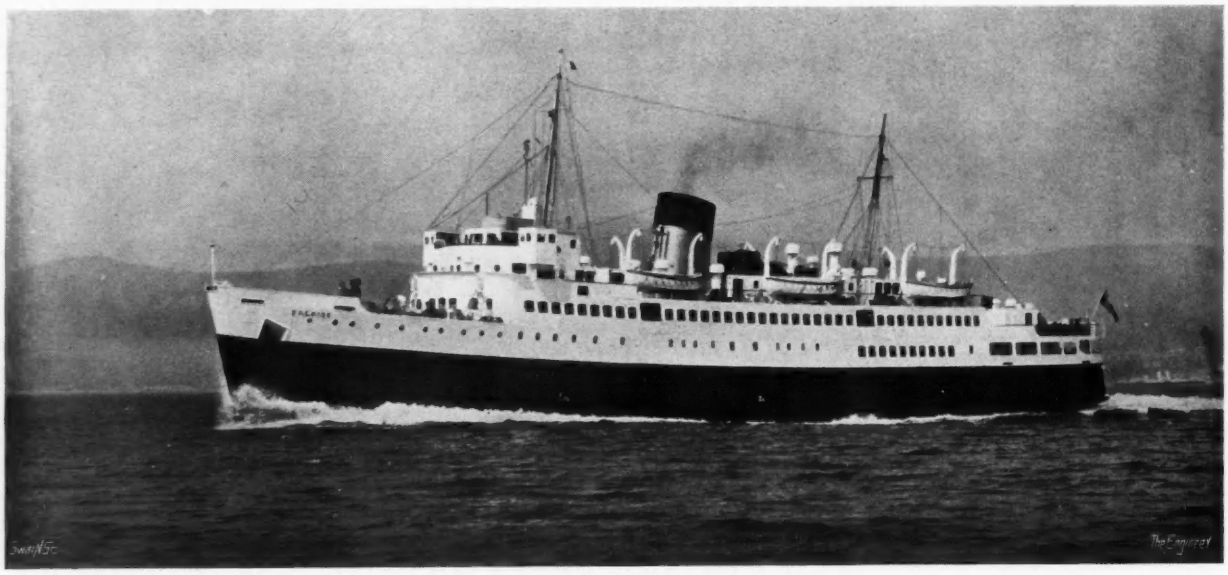


EXPERIMENTAL 950 B.H.P. "WERKSPOOR-LUGT" OIL ENGINE ON TEST
BROWN-BOVERI 10,000-KW GAS TURBINE SET ON TEST

CROSS-CHANNEL STEAMERS OF 1947

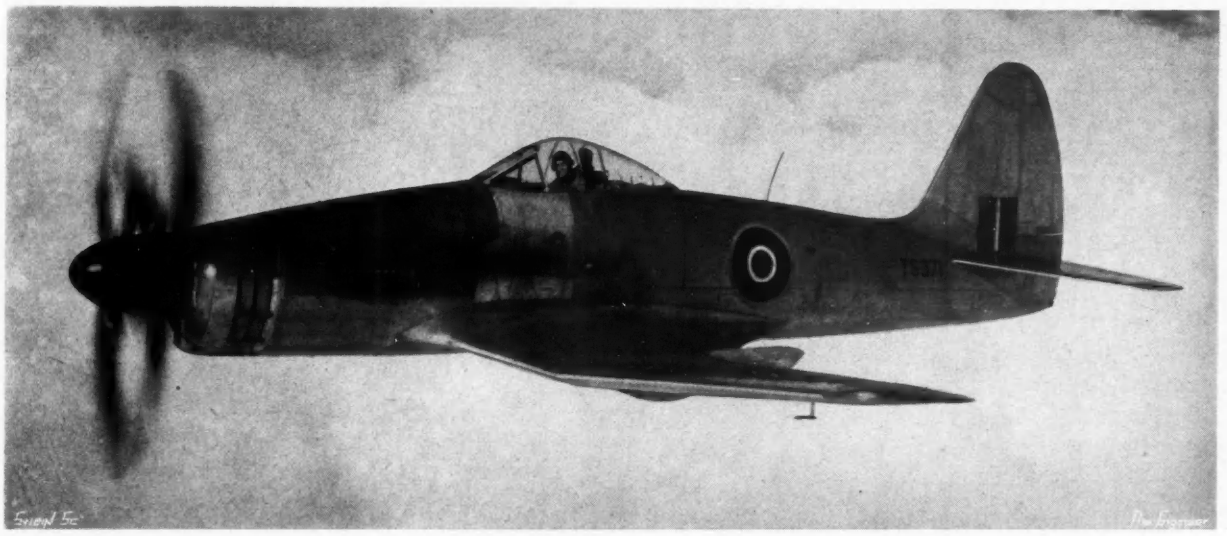


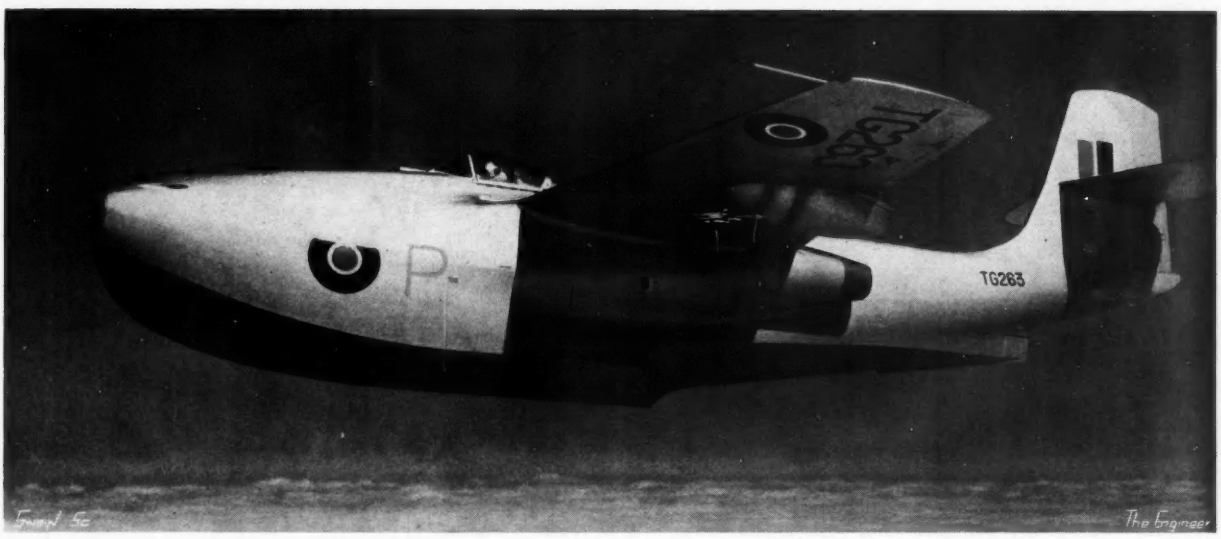


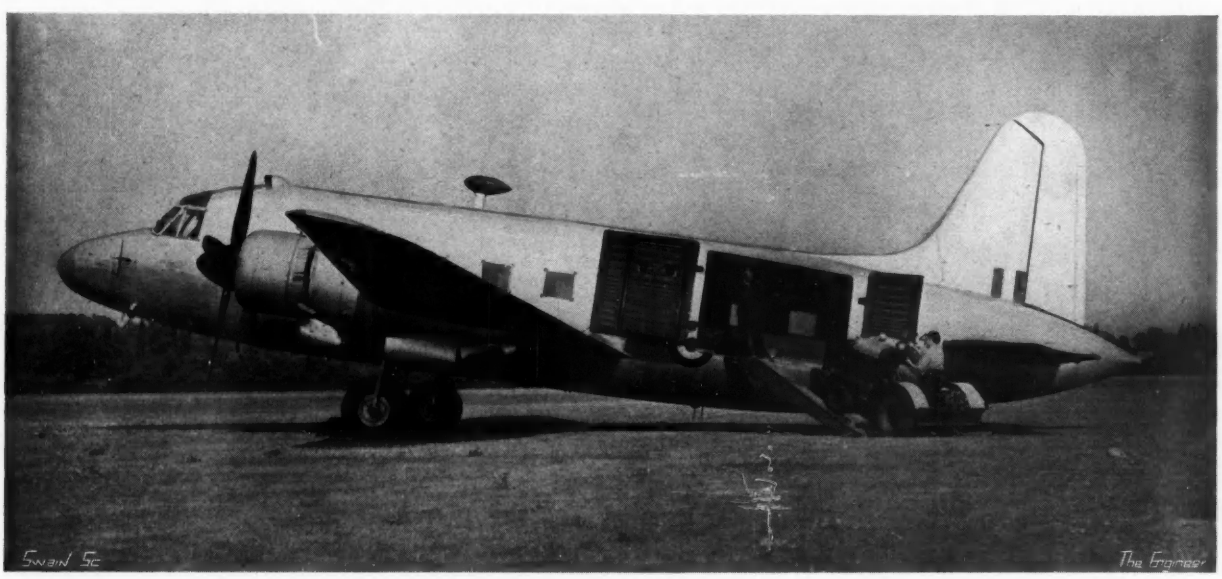


L.N.E.R. HARWICH–HOOK STEAMER "ARNHEM"
L.M.S. LARNE-STRANRAER M.S. "PRINCESS VICTORIA"
S.R. CROSS-CHANNEL STEAMER "FALAISE"

NAVAL AND MILITARY AIRCRAFT OF 1947

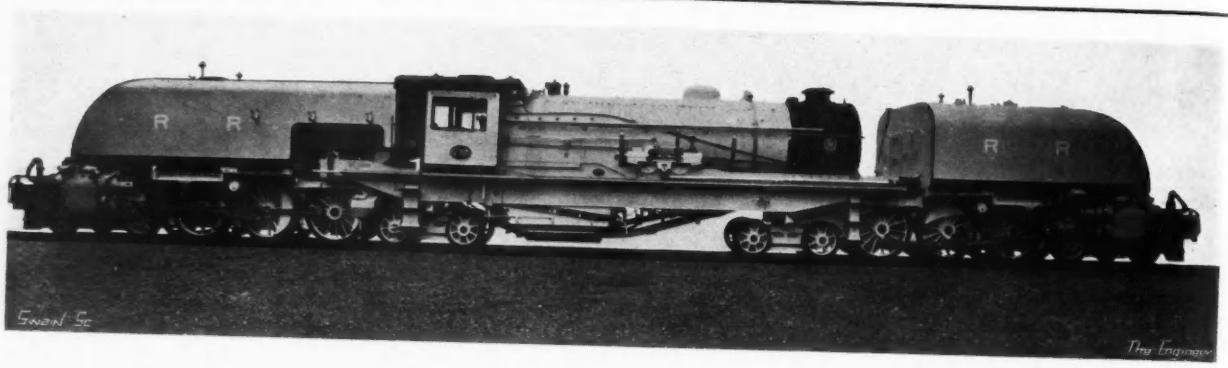


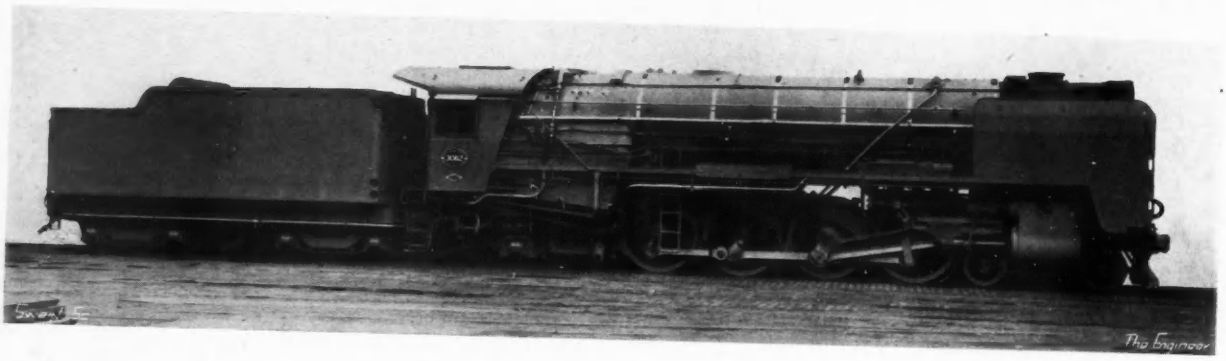


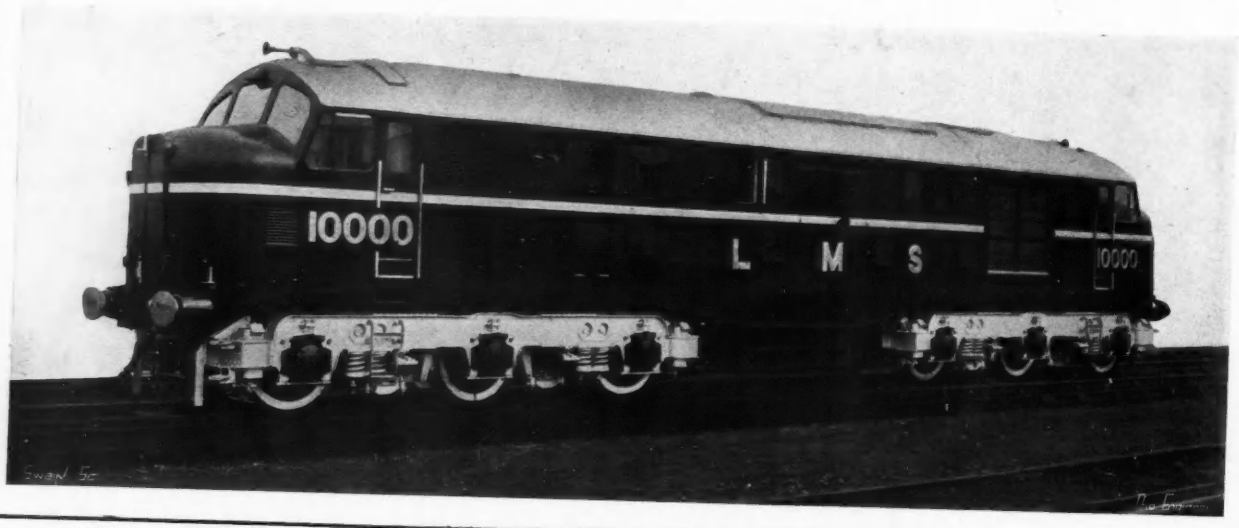


WESTLAND "WYVERN" NAVAL SINGLE-SEAT FIGHTER
SAUNDERS-ROE "SR/A1" JET-PROPELLED FLYING BOAT FIGHTER
VICKERS "VALETTA" MEDIUM MILITARY TRANSPORT

LOCOMOTIVES OF 1947







BEYER PEACOCK 4-6-4+4-6-4 BEYER-GARRATT LOCOMOTIVE FOR THE RHODESIAN RAILWAYS
NORTH BRITISH 4-8-2 LOCOMOTIVE FOR THE SOUTH AFRICAN RAILWAYS
L.N.E.R. 4-6-2 CLASS "A2" LOCOMOTIVE
L.M.S. DIESEL-ELECTRIC LOCOMOTIVE NO. 10,000

A Seven-Day Journal

The New Year Honours List

In the list of New Year Honours conferred by the King, and published on Thursday, January 1st, the following names appear :— The Right Hon. Baron John Scott Hyndley, the Chairman of the National Coal Board, becomes a Viscount. Sir Valentine George Crittall, chairman of the Crittall Manufacturing Company, Ltd., and Darlington and Simpson Rolling Mills, Ltd., becomes a Baron. Knighthoods are conferred upon Colonel Eric Gore-Browne, chairman of the Southern Railway Company ; Prof. John Douglas Cockcroft, F.R.S., Director of the Atomic Energy Research Establishment, the Ministry of Supply ; Mr. Vincent Ziani de Ferranti, chairman of Ferranti, Ltd.; Mr. Philip Bulmer Johnson, President of the Engineering and Allied Employers' National Federation, and general manager of the engineering department of R. and W. Hawthorn Leslie and Co., Ltd.; Mr. Charles Garonne Renold, Chairman of the British Institute of Management, and chairman of the Renold and Coventry Chain Company, Ltd.; Mr. Harry Ralph Ricardo, F.R.S., chairman of Ricardo and Co., Ltd., and Prof. Richard Vynne Southwell, F.R.S., Rector of the Imperial College of Science and Technology, the University of London. In the Civil Division of the Order of the Bath, Mr. G. M. McNaughton, Chief Engineer, the Ministry of Health, receives the C.B. In the India Office List, the C.S.I. is conferred on Mr. T. A. W. Foy, Chief Engineer and Secretary of the Government of Punjab in the Department of Irrigation, and the C.I.E. on Mr. G. M. McKelvie, Consulting Engineer (Roads) to the Government of India, and Mr. W. L. Murrell, Chief Engineer and Secretary to the Government of Bihar (Public Works Department). Mr. W. B. C. Kelland, Chief Engineer of the Bengal Nagpur Railway, is awarded the C.B.E., and Mr. Norman Frederick Frome, Chief Engineer of Posts and Telegraphs, receives a Knighthood. In the Order of the British Empire, Rear-Admiral (E.) J. L. Bedale becomes a K.B.E., and Rear-Admiral (E.) G. H. H. Brown, a C.B.E. In the Civil Division, Sir Frank Spencer Spriggs, managing director of the Hawker Siddeley Aircraft Company, Ltd., becomes a K.B.E. The C.B.E. is awarded to Mr. G. L. T. Brough, Departmental Director of Electrical Engineering, the Admiralty ; Mr. E. Graham Clark, secretary of the Institution of Civil Engineers ; Mr. W. J. Dawson, late metallurgical director of Hadfields, Ltd.; Major J. B. Halford, chief engineer and director of the De Havilland Engine Company ; Mr. R. G. Hosking, chairman of the East Midlands Regional Committee of the Engineering and Allied Employers' National Federation ; Professor W. Kerr, the Royal Technical College, Glasgow ; Mr. F. A. King, Kelvin and Hughes, Ltd.; Mr. F. M. Service, director of William Beardmore and Co., Ltd.; and Mr. J. P. Watson, special director of Vickers-Armstrongs, Ltd., Crayford.

Centenary of the Societe des Ingenieurs Civils de France

It is announced that the Société des Ingénieurs Civils de France will celebrate its centenary by a special series of meetings and social events, which will take place in Paris from May 29 to June 3, 1948. On Saturday, May 29th, the foreign delegates will be received at the home of the Société at 19, Rue Blanche, Paris. The following day, Sunday, is set apart for the Solemn Celebration, which will take place at the Sorbonne, 1, Rue Victor Cousin, at which the President of the French Republic, Monsieur Vincent Auriol, will preside. At this meeting the congratulatory addresses of the different institutions in France and abroad will be presented. On Monday, May 31st, and the succeeding days, June 1st, 2nd and 3rd, morning meetings will be held at the home of the Société, at which papers will be presented dealing with various sections of engineering activity. In the afternoons and evenings social meetings have been arranged, and they will include a reception, a gala theatre performance, visits in and around Paris, and an official Government reception at the Palais de l'Elysee. From the evening of June 3rd to the morning of June 9th, visits to places and installations of outstanding technical interest in France have been arranged. The British Section of the Société has, in connection with the centenary celebrations, arranged four meetings in London. On Friday, January 30th, at the Institution of Civil Engineers at 5.30 p.m., Mr. M. G. H. McHaffie, M.I.C.E., will deliver his Presidential Address on " Passenger Accommodation at Ports " ; on Thursday, February 19th, at 5.30 p.m., at a joint meeting with the Institution of Civil Engineers, Monsieur M. L. Carpenter will give a lecture on " The Reconstruction of Railway Bridges in France." At another joint meeting at the Institution of Civil Engineers at 5.30 p.m. on March 11th, a lecture will be given by Monsieur Andre Rumpler, on " Some Examples of the Reconstruction of Road Bridges in France." Finally, on Thursday, April 22nd, at a joint meeting with the Institution of Structural Engineers in the Hall of the Institution of Structural Engineers, Monsieur R. Koechlin will give a lecture on " Hydro-Electric Works in Switzerland with particular reference to the Rossens Dam."

A Committee on Road Safety

The Minister of Transport has now set up a Committee on Road Safety as a permanent feature of his Ministry's organisation in relation to the study and prevention of road accidents. The committee, over which the Parliamentary Secretary to the Ministry of Transport, Mr. J. Callaghan, will preside, is composed of members of the various Government departments concerned, representatives of the Police, Education and Local Authorities, Road Users' Associations, the Royal Society for the Prevention of Accidents, and the Trades Union Congress. The function of the committee will be to advise the Minister on such matters relating to road safety as he may refer to it, and it will also consider and report on other questions which appear to be of importance regarding the prevention of road accidents.

Report on the L.N.E.R. Doncaster Collision

The Report of Sir Alan Mount, and Brigadier C. A. Langley, Inspecting Officers of Railways, to the Minister of Transport, following the enquiry into the collision which occurred on August 9, 1947, near Doncaster, on the London and North Eastern Railway, has now been published by the Stationery Office. It will be recalled that the accident took place at 4.41 p.m. on Saturday, August 9th, between Bridge Junction and Balby Junction signal-boxes, about ¾ mile south of Doncaster. The No. 958 down express passenger train, the 1.25 p.m. from King's Cross to Leeds, was improperly allowed to enter the occupied section ahead of Balby Junction under clear signals, and collided at a speed of about 40 miles per hour with the rear part of the No. 956 down passenger train, the 1.10 p.m. King's Cross to Leeds, which had stopped at Balby Junction home signal, and was just moving forward when the accident occurred. Each train was heavily loaded and carried approximately 700 passengers, some of them standing in the corridors. Eighteen passengers lost their lives and 118 passengers were injured, fifty-one of whom were detained in hospital. The driver and train attendant of the 1.25 train also suffered injuries. The signalling at Doncaster had long been due for modernisation, and work on a comprehensive scheme was begun before the war and then postponed. It was restarted in 1946 and was due for completion at the end of last year. The accident, the report says, would not have occurred had the remodelling of the signalling arrangements at Doncaster been completed. Very serious responsibility, the report states, rests upon signalman McKone for accepting the following express and for lowering his signals for it to enter the section to Bridge Junction before obtaining the " line clear " for the train from signalman Taylor, or even receiving " out of section " from him for the preceding train.

The Coal Resources of Queensland

It is announced that plans have now been completed for the making of a complete survey of the coal resources of Queensland, and the drawing up of recommendations for their most efficient development. The assessment will take into account the fuel requirements of the State for all industrial purposes, including the use of coal for the production of gas and electricity ; the possible development in the State of secondary industries based on coal or its derivatives, and the coal resources and requirements of Australia as a whole, including export possibilities. Any plan of development which is recommended will, we learn, aim at ensuring the most efficient methods of coal mining and management, the best conditions for miners and other employees, and the most effective use of the coal won and its derivatives. The terms of the survey, which are drawn up in the widest possible manner, cover the whole range of problems, which it is thought will arise in connection with the development of Queensland's coal resources. The agreement, which was concluded in November last between the Government of Queensland and Powell Duffryn Technical Services which will conduct the survey, was signed by Mr. E. M. Hanlon, the Premier of Queensland, and by Mr. Robert Foot, the chairman of Powell Duffryn Technical Services, and it will run for an initial period of twelve months from November 1, 1947. It includes provision for the taking of samples, and their testing in the company's Central Research Laboratory at Battersea.

British Exhibition at Copenhagen

It is announced by the Federation of British Industries that with the approval of the British and Danish Governments the Federation and the British Import Union of Copenhagen, arrangements have been made for an exhibition of British goods from September 18 to October 3, 1948, in Copenhagen. His Majesty the King, and H.M. King Frederick of Denmark, have consented to become Patrons of the Exhibition, and already Vice-Patrons and a lengthy British Committee of Honour have been chosen. The aim of the Exhibition will be to encourage export trade to the Scandinavian and neighbouring markets. The exhibits of the engineering, chemical, building and associated industries will be accommodated in the Forum Exhibition Building, which is the largest of its kind in Copenhagen. The textile and miscellaneous industries will display their exhibits in the Tivoli Gardens, while those of the transport industry, including motor cars and motor vehicles, will be shown in the Royal Riding House. It is hoped to arrange suitable sites on the outskirts of Copenhagen for the display and demonstration of British aircraft. The total area will, we understand, be roughly that of the British Exhibition, which, we may recall, took place in Copenhagen in 1932, but already much interest has been shown and there may be a difficulty in satisfying all claims on the space available. Firms wishing to take part in the Exhibition are requested to make early application for space to the Exhibition Committee, the British Import Union, Raadhuspladsen, 45, Copenhagen, or to the London Office of the Copenhagen Exhibition, at Earl's Court Building, London, S.W.5.

The State of the Navy

(By a Naval Correspondent)

No. II—*(Continued from page 4, January 2nd)*

Dockyards

THE various references to the dockyards in the earlier paragraphs give some indication of the important part they play in maintaining the fighting efficiency of the Fleet. Rumours have been going round that one or more dockyards might have to be closed down in order to reduce naval expenditure. After the 1914–1918 war, Rosyth Dockyard was sacrificed on the altar of economy and the decision to reopen it was not taken till just after Munich, and, in consequence, this most useful dockyard was not fully effective in the critical early years of the war. Although dockyard workmen have specialised in naval repairs and shipbuilding, they are highly skilled men in their respective trades, and the Admiralty have agreed to their employment on repayment contract work in order to help industry and, at the same time, eke out the limited funds allowed to the yards out of the Navy Vote. It is to be hoped that such measures may be sufficient to enable the Royal Dockyards all over the world to be kept going through this critical period of financial stringency.

H.M.S. "WARSPITE" AGROUND OFF THE CORNISH COAST

Naval Shipbuilding

With the termination of the war, the naval shipbuilding programme was heavily cut and such construction as was left in the programme was given a lower priority in order to enable the shipbuilding and engineering industry to concentrate on merchant shipbuilding and other work more in keeping with the production drive. The life of warships is, however, limited, and though it is possible to extend their useful lives by a large and costly refit, it is not possible to convert an old ship into the equal of a new one. It is, therefore, essential that a planned new construction programme should be restarted as soon as circumstances permit. Apart from the naval aspect of this requirement, it is necessary to consider the needs of industry. Most shipbuilders had full order books in 1947, due to the need of new ships to replace those lost during the war, but this happy state of affairs is unlikely to continue indefinitely, as the capacity of the industry is greater than necessary to meet the normal replacement building of merchant ships when a state of stability has been established. One remembers the grim years for the industry between the wars, and it is hoped that action will be taken in time to prevent another slump with its accompanying unemployment and the loss of skilled men to other industries. A live and up-to-date industry is essential to support the Navy in time of war, and it therefore seems appropriate that when the merchant shipbuilding programme begins to slow down a naval programme may be available to keep our shipyards employed.

Naval Activities

Naval activities during the year were gravely limited by the limitations on fuel supplies; essential tasks were carried out and the rest of the available fuel was shared out between the various fleets. Of these essential duties, reference has already been made to the work of the minesweepers and wreck-disposal vessels, and of the destroyers of the Palestinian Patrol. Small naval squadrons were also maintained at Trieste during the occupation period, but were later withdrawn; this was a joint British and American commitment, and the British ships were units of the Mediterranean Fleet. Other ships of this fleet visited Greek and Turkish ports and made contact with the Russians at Sevastopol.

The American and West Indies Squadron showed the flag on both east and west coasts of North and South America, and the Home Fleet made two cruises, in the spring to Portuguese, Mediterranean and West African ports, and in the summer to ports in Norway, Sweden and Denmark. After their return from the latter cruise, the Home Fleet assembled in the Clyde, together with the ships of the Training Squadron and other naval units, and were visited by Their Majesties.

Naval ships are sometimes called on to do unusual duties and such a case arose in the first quarter of 1947, when, at the height of the fuel crisis, H.M. Submarines were used to supply electric power to the Royal Dockyards in order to save coal.

Probably the best-known naval activity was the trip of H.M.S. "Vanguard" to South Africa with the Royal Family on board. The total distance steamed was approximately 12,000 miles and the machinery and equipment functioned satisfactorily throughout the trip. Considering the ship had only left the Clydebank yard of Messrs. John Brown and Co. a few months earlier, this was a compliment to the good work done by the shipbuilders and a creditable performance by the engineering department of the ship.

Refuelling at Sea

On both outward and homeward journeys, "Vanguard" refuelled at sea. Although, under peacetime conditions, this operation is seldom required, two methods of refuelling were developed before the war. Even under war conditions, it is only infrequently that this operation is necessary in the narrow waters of the North Sea and the Mediterranean, and then generally only the refuelling of destroyers from the larger ships of the fleet. The number of refuellings at sea, however, began to grow during the Battle of the Atlantic, to enable the submarine-hunting flotillas to remain longer on their hunting grounds, and to enable the escort vessels to remain with their convoys. It was soon apparent that improved methods were necessary and work on their development was immediately put in hand. Very satisfactory progress was made, but when the Fleet had to operate in the wide, open seas of the Pacific Ocean, the problem became a much bigger one, as not only was it necessary to refuel, but also to transfer ammunition, stores, &c., to the ships, big as well as small. By good seamanship and improvisation this was accomplished, but it was evident that this was a new requirement which had to be met by new methods.

The problem was considered sufficiently urgent to justify the conversion of a German auxiliary vessel as a Fleet Replenishment Ship and it is satisfactory to note that a series of trials was carried out between this ship (renamed "Bulawayo" in honour of a resident of Southern Rhodesia who bequeathed £63,000 to the United Kingdom Government to be devoted to a ship of the Royal Navy), and units of the Home Fleet, including a battleship, a cruiser and a destroyer. These trials were very satisfactory and provided useful information for the ships' officers, who carried out the operation, and for the Technical Departments of the Admiralty.

All the big ships of the Pacific Fleet have now returned to Home waters, but many of them have steamed vast distances, particularly the aircraft carriers, which have been used for trooping purposes, since the end of the war, and which it is estimated steamed a million miles on this service and brought home 100,000 men and women to be demobilised.

New Building

The only new ships which joined the Fleet during the past year are six "Battle"

class destroyers, five " A " class submarines, and two " Weapon " class destroyers. The latter is a new class and the main interest lies in the machinery arrangement; there are two boiler-rooms and two engine-rooms, the after boiler-room being situated between the engine-rooms. This subdivision of machinery spaces has been common practice in bigger ships for some years, but has not previously been adopted in destroyers in the British Navy. The arrangement has the disadvantage of the adoption of two funnels, but this is not very apparent as the forward funnel has been run up inside the lattice mast. Another novel feature of the machinery is the adoption of higher steam conditions, namely, 430 lb per square inch and 750 deg. Fah. in lieu of the 300 lb per square inch and 650 deg. Fah., which have been standard practice in previous British destroyers. There are several new features in the machinery of these ships and, naturally, some teething troubles were experienced on trials; it is, therefore, earnestly hoped that these ships will be given as much running as possible to test out these new features.

One other new vessel is worth mentioning, namely, " M.G.B. 2009." This is the first naval vessel to be fitted with a gas turbine and running experience to date has been most promising. Details of the machinery of this craft were published in THE ENGINEER, in the issues of September 5, 12, and 19, 1947, and it is unnecessary to refer to them here, but it may be of interest to refer to the origin and purpose of this design. The main object was to obtain running experience of a gas turbine in a seagoing vessel as soon as possible. The original intention was to fit two of these units in a four-shaft craft, the gas turbines being fitted on the two centre shafts and diesel engines on the two wing shafts; unfortunately, this scheme fell through and the present three-shaft arrangement, with one gas turbine on the centre shaft and petrol engines on the two wing shafts, was accepted; it was appreciated that there might be some danger in fitting a gas turbine in a petrol engine compartment but it was decided to take this risk in order to expedite the trial. The gain in speed will scarcely be sufficient to be of much value to the Naval Constructors, but it is hoped to learn sufficient to justify a further step forward to a really fast craft fitted with gas turbines only. This is a bigger problem altogether, as the gas turbines will have to be designed for economy throughout the power range, whereas in the present design, economy at low powers is given by the reciprocating engines and the gas turbine has mainly been designed for full-power running. Careful consideration has also been given to the use of gas turbines in bigger ships and an experimental unit is under construction.

Progress in the " Daring " class destroyer machinery was disappointingly slow, owing to the concentration of the marine engineering industry on the machinery for the merchant shipbuilding programme. The first machinery unit should, however, be ready for shop tests during 1948 and these trials will be carried out in the test shop of the Parsons and Marine Engineering Turbine Research and Development Association. This will be an outstanding event in the history of marine engineering, as the shore trial of a high powered marine steam unit at full power has never been done before in this country. Much useful data should be obtained from these tests, which should be of great value to the designers of future steam machinery for warships and even for the larger ships of the merchant navy.

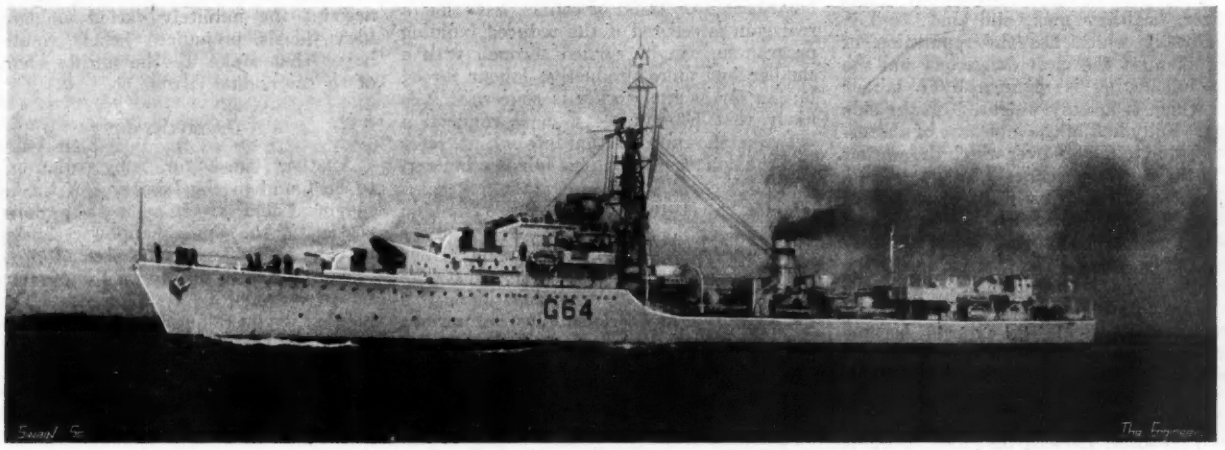
SHIPS' TARGETS

The essential need for full-scale trials is becoming more appreciated in these days, and another example is given by the work of the Ships' Target Trials Committee. During the war, examinations of ships damaged by enemy action were carried out immediately on their return to harbour, but the time available was limited due to the urgent need of getting the ships repaired and back on service. The importance of such examinations was, however, realised, and in 1945 an Admiralty Committee was appointed to make recommendations for using surplus warships of all types for experimental purposes with the object of obtaining reliable design data from full-scale experiments carried out under controlled conditions, on the effects of underwater explosions, bombs and shells on the structure and equipment of ships, and also related subjects, such as the design and effectiveness of new weapons, &c. It is estimated that the whole programme of trials will take several years, but a useful start was made during the past year using various types of ships and craft as targets, from light coastal craft to big ships, such as cruisers and aircraft carriers.

The above remarks indicate that the technical departments were not idle during the year and that research and development work is proceeding in all fields, including armaments, radar, &c.; most of this work is, however, on the secret list and cannot be discussed here. In addition to its own research, the Admiralty is closely interested in the research of other Government Departments; for instance, in that of the Ministry of Supply in the fields of nuclear energy, rockets, &c. It is of the utmost importance that the post-war research programme should be progressed as rapidly as possible to ensure that when naval construction is restarted our warships shall be designed to withstand the effects of the most lethal weapons in existence or contemplated and shall be fitted with the most modern and efficient machinery and equipment.

PAYING-OFF OF SHIPS

On the conclusion of the war many fine ships have been paid off from the Navy, but have still served their country by providing scrap material for the iron and steel and non-ferrous industries. The story of one such ship, the " Warspite," may serve to conclude this article. This grand old veteran of Jutland served with distinction throughout the 1939–1945 war, and was in action at Narvik, Fort Capuzzo, Valona, Bardia, Tripoli, Matapan, Crete, Salerno, the Normandy beaches, Walcheren and in the Far East. It may not be known that throughout her last three actions she was mortally wounded internally. She had been damaged by bombs off the coast of Italy in 1943; a direct hit on the port side destroyed one boiler-room and caused flooding of several other machinery compartments, and a near miss on the starboard side caused further flooding. After patching at Malta dockyard she proceeded to Gibraltar partly under her own power and partly in tow. Further patching by Gibraltar dockyard enabled her to return to England under her own power. At Portsmouth she received further treatment, which enabled her to take her appointed place in the battle line on D-day. On retirement from the Normandy beaches for re-ammunitioning, she received further damage from a mine which quite upset her shaft alignment, but an outstanding bit of improvised repair work by Rosyth dockyard enabled her to return to the Normandy beaches and later to Walcheren to complete her bombardment duties. On passage in tow to the shipbreakers she broke adrift in a storm and was wrecked on the Cornish coast in March, 1947. In the words of the old American marching song, her " body lies amouldering in the grave, but her soul goes marching on," and it is to be hoped that a new " Warspite " will soon be sailing the seven seas under the White Ensign.



" WEAPON " CLASS DESTROYER H.M.S. " SCORPION "

Labour in 1947

By GERTRUDE WILLIAMS*

No. II—(*Continued from page 6, January 2nd*)

Hours of Work

IN the coal-mining industry the hours question became particularly acute, for the five-day week was one of the most ardently desired corollaries of nationalisation. It had been hoped, and even promised, that the reduction of the working week would give such a fillip to production that output would not suffer, but, unhappily, this hope was not fulfilled, and the absenteeism rate, taking into account the smaller number of possible shifts, remained as high as before. In the months following the introduction of the shorter week the absentee percentage of workers at the coal face fluctuated between 12 and 14. Not all of this, of course, was voluntary; it must be remembered that the great exodus from the coalfields before and during the war was composed mainly of the younger, healthier men, and that, to-day, an industry which has the reputation of being amongst the most dangerous and the most exhausting is manned by a labour force which is heavily weighted on the side of age. Fully half of the high rate of absenteeism is due to factors over which the worker has little control—sickness, accidents, &c. Yet, whatever the justification, the fact remains that the necessary output was not achieved; and the miners had reluctantly to agree to a longer working week during the winter months. Output in consequence was rising towards the end of the year and even a small trickle of exports became possible.

It is not only the miners who have regarded the reduction of the working week as one of the most valuable objectives to strive for. Very little modern industrial work is sufficiently individualised to provide much compensation for the nervous strain and fatigue it causes, so that an increased amount of leisure in which one can be one's own man, naturally enough, ranks very high in the order of preferences. How anxious most people are to get and to retain a greater amount of leisure can be seen from the fact, recorded by the Ministry of Labour, that during the first ten months of the year there was an average reduction of the working week by 3½ hours, covering about 5,000,000 industrial workers (shop assistants, clerks, &c., are not included in these statistics) and that the rank and file of the cotton industry refused to accept the agreement made by their union representatives with the employers that longer hours should be worked during the present crisis.

There is, of course, no reason at all why people should not choose for themselves what makes life worth living so long as they do not demand irreconcilables; but most of us want to have our cake as well as eat it. There is a lot to be said for cutting down work so as to leave time and energy for enjoying the fruits of one's work, but a shorter working day can only be accompanied by a higher material standard of living provided that output per manhour increases as the number of hours is reduced. So far it is generally true to say that this has not been the case during the last few years and one of the major tasks that confront us now is to find means to achieve it. One example is to be found in the building industry, where the longstanding opposition to payment by results has been due partly to the genuine belief that it led to scamped work and partly to the conviction that it was in the interests of the worker to make the job last as long as possible in an industry in which the hold on employment was always so precarious. Despite the colossal arrears of building work that had piled up by the end of the war, this traditional belief remained securely in possession, and it has taken two years of argument to reach an agreement to introduce piece-work rates. By one of life's little ironies, the decision was reached just at the moment when the drastic reduction in capital expenditure had to be made and the field of employment for building labour consequently narrowed. It is extremely unfortunate that this should have been so. It is, of course, true that a real gain is secured if the reduced building programme can be carried through with a smaller but more productive labour force; but so far as the worker is concerned it is likely that he will see a close connection between the introduction of output rates and the danger of losing his job as a builder.

Industrial Disputes

On other sections of the labour front the scene is nothing like so gloomy. The year 1947, like 1946, was remarkable for the absence of any serious industrial unrest; the number of days lost through disputes was slightly higher, but negligible in comparison with the time lost from the same cause in the comparable period after the first world war. As so often happens, coal mining accounted for more strikes than any other occupation and, in fact, 40 per cent of all the days lost through disputes were in that industry. The most important dispute, the one at Grimethorpe, in which so many others were sympathetically involved, is particularly interesting and significant because the ostensible cause was so different from the real issue. The conflict arose over the increase in working hours (mentioned above): should the extra hours be spread over the normal working week of five days or should they be concentrated in an extra Saturday shift? The former would involve a recalculation of the "stint" (i.e., the amount of the coal face to be tackled in a given period) and would result in a larger amount of work at normal rates of pay; the latter would make it much easier for those who wished to do so to evade the extra work by voluntary absenteeism, and would ensure that the extra, if it was done, would be paid at overtime rates. But the bitterness of the dispute was not due primarily to differences of opinion on these alternatives but to deep seated resentment on the part of the miners that new conditions were being imposed on them from above without consultation with those most concerned in the change. The great natural variations in the coalfields in different areas have developed a strong local spirit amongst miners who have long been accustomed to make local agreements with their employers on the basis of the nationally negotiated collective bargains. Throughout the long period that miners have been agitating for the expropriation of the private coal owner, the inspiration behind the movement has been syndicalist rather than collectivist, and most of them believed that the nationalisation of the mines would give the worker still more voice in the settlement of local working rules, instead of less. To give up private enterprise with its local variations for nationalisation with uniformity seems to many not quite what they wanted and most miners strongly oppose the exercise of absolute authority by the remote Board, which is now their employer. The besetting sin of every giant concern is to rate too highly the value of an efficient and tidy administrative machine. A neat system, carefully worked out on a rational principle, seems very attractive to the people in the central office; but out in the field of actual practice human nature will keep breaking in, with its local traditions and prejudices and its irrational, but extremely powerful, sentiments. The Grimethorpe dispute was important because it forced so vividly into the public mind the realisation that no system of administration, however scientifically composed it seems to be, will prove workable in practice unless it takes into account the infinitely varied amalgam of ideas, ideals, prejudices, beliefs, rights and hopes that make up the untidy character of the individual citizen.

Unemployment

Another cause for congratulation was to be found in the low level of the unemployment figures. In view of the long discussion of the acute manpower shortage it may be thought that the absence of severe unemployment is hardly worthy of mention; but this would be to allow oneself to be blinded by overall percentages. Before the war there was a very large hard core of unemployment, which persisted throughout the periods of greatest prosperity in South Wales, Cumberland, Tyneside and Scotland, and it was feared that the removal of war demands would allow this depressing pattern to re-emerge. Government action, however, prevented it happening. The policy of "taking work to the worker" was given official sanction in the White Paper on Employment Policy, published in 1944, and it has since been implemented through the administration of the Distribution of Industry Act, and the Supplies and Services (Transitional Powers) Act of 1945. By granting priorities in building and in derequisitioning to firms willing to establish themselves in these areas, new industries are being steered into localities in which they will provide a more stable and balanced variety of occupations than existed in the past. The conversion of Government factories to peacetime uses takes time, as do the provision of basic services and the training of local labour in the requirements of the new types of work. A year ago the process was just beginning to get under way and most new businesses were in the stage of "becoming" rather than of "being," and were not able yet to offer employment to very large numbers. By the end of 1947, however, many of the new projects were in working order with the happy result that the percentage of unemployment fell to record low peacetime levels. Even in Wales, by common consent the most difficult area to deal with, the average rate is now only 5 per cent and in the other Development Areas it is as low as 2 and 3 per cent.

Two other developments call for brief comment—both of long term importance—the Interim Index of Retail Prices and the completion of the great scheme of social

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security through the National Assistance Bill.

Cost of Living

The original Cost of Living Index came into existence in 1914 and, through force of circumstances, was introduced without the comprehensive investigation that should have preceded it. At the beginning of the first world war it was quickly realised that prices would rise steeply and that it would be essential to have some clear way of measuring changes in real wages. Unfortunately, there was very little knowledge of the pattern of working-class expenditure and a good deal of guesswork had to go into the making of the index. Some ten years earlier, in 1904, a couple of thousand "typical" working-class budgets had been collected and these gave some indication of the kinds of expenditure that bulked most largely in these households. For lack of anything better, it was assumed that an index weighted in these proportions would give a working method of measuring the changes in the real value of wages as prices altered. All that the Cost of Living Index attempted to do was to calculate the cost to a working class family, month by month, of the purchase of the same goods and services, and in the same proportions, as had been bought for £100 before August, 1914, assuming that the pattern of expenditure was the same as it had been in 1904.

Nothing more could have been done at the time. There was neither labour nor leisure to find out how people really did spend their money and whether a rise in the price of sugar would have more or less effect on the standard of living than a rise in, say, the prices of fuel or clothes. Moreover, an enquiry undertaken then, even if there had been time to do it, would not have been of much value, for wartime shortages naturally caused involuntary changes in expenditure which would be reversed as soon as goods could be freely produced again. As time went on the index grew fantastically inappropriate, for there has probably been no previous period in which the habits of life of the mass of the population have undergone such profound alterations as during the present century. Particularly in the deflationary period of the twenties, when prices were falling rapidly, the combined effect of nationwide collective agreements and unemployment insurance benefit introduced into wage rates a greater degree of rigidity than they had ever possessed before, so that for those who were in employment real wages rose considerably. At the same time the spread of mass production methods in the production of consumption goods has brought a wide variety of commodities within reach of the working-class family and established new conventions of living. One has only to compare the clothing of the working-class woman to-day with that of pre-1914 to appreciate the revolutionary changes that have been brought about. Forty years ago the working girl had one "best" dress, which had to last so many years that it could have no more than a nodding acquaintance with fashion; but the development of rayon textiles and mass produced clothing reduced prices so considerably that the majority of working girls nowadays can follow the mode almost as quickly as the duchess. What has happened in clothing has happened in many other things, and the wage earner to-day has (or, at least, had before civilian production was so severely curtailed) as varied a pattern of consumption as any other class. Furniture, kitchen equipment, curtains and radio play an important part in his household budget and drink and tobacco and entertainments in his personal one.

The 1914 Cost of Living Index assumed a very spare way of life in which there was no margin for anything but the fundamental essentials. According to that index, 60 per cent of the income of the working class household went on food, 12 per cent on clothing, 16 per cent on rates and rent, 8 per cent on fuel and light and only 4 per cent was left for everything else. No allowance was made for drink or tobacco, nothing for furniture or household equipment and nothing for transport or other services.

A revision of the index would certainly have been undertaken earlier had it not been for the prolonged depression in many important industries; but it was felt that an examination of budgets at a time when 3,000,000 households were living on unemployment insurance benefits or allowances would not be of any positive value in indicating the normal pattern of consumption. The enquiry was not, therefore, undertaken until 1937–8, and its results were not available until shortly before the war, so that action had to wait until this year. A representative committee was set up to advise the Minister of Labour and the new Interim Index of Retail Prices has been based on its recommendations.

The new index takes account of the much wider variety of goods and services that now figure in working-class expenditure and, based as it is mainly on the results of the 1937–38 investigation, it is interesting evidence of the way in which the proportion of the income spent on food and clothing drops as a higher standard of living allows a larger margin for comforts and luxuries. The proportion of income spent on food falls from 60 to 34·8 per cent, and on clothing from 12 to 9·7 per cent, despite the fact that in both these categories the worker now enjoys a quality, variety and quantity (war shortages apart) that were denied to his predecessor of forty years ago. That rent and rates should drop from 16 to 8·8 per cent is due mainly to the fact that rents have been controlled throughout the greater part of the period while fuel and light show the least change, from 8 to 6·5 per cent. But the most striking alteration is to be found in the new categories of expenditure now included for the first time and which show that 21·7 per cent of the income is spent on drink and tobacco, 7·1 per cent on household durable goods, 7·9 per cent on services (transport, &c.), and 3·5 per cent on miscellaneous articles.

The new index was published for the first time in July with mid-June as the base date, which means that from then, the index measures the amount of money that would be needed by an ordinary working-class household to buy the same goods and services, in their accustomed proportions, as it could have bought for £100 in June, 1947. The latest figure published is 103, which shows that prices had risen 3 per cent since June.

The index is of great practical importance because a fair number of wage agreements are tied to it, wage rates rising and falling by an agreed amount for every so many points change in the index. The new basis of calculation results in movements in the index that were not contemplated when the wage agreements were negotiated and, because of this, several months' notice was given of the changes to be made. It may be that this connection between wage rates and the index influenced the Chancellor of the Exchequer when he framed the autumn Budget. A strong body of opinion urged that the subsidies to food and clothing (totalling about £400 millions annually) should be reduced, so that higher food prices, more consistent with their costs of production, might absorb some of the extra purchasing power whose chase of non-existent articles has sent uncontrolled prices soaring so steeply. As the expenditure on food and clothing together represent 45 per cent of the total, the Price Index would rise sharply if subsidies were withdrawn and would be followed by an automatic upward movement of all wages governed by it unless new agreements were negotiated.

National Assistance Bill

Finally, a word about the National Assistance Bill, which was introduced into the House of Commons in October and which met with such universal approbation that its main clauses are certain to become law very shortly. This Bill represents the culmination of forty years' development of social provision designed to maintain a reasonable minimum standard of living throughout the various vicissitudes of life. In the early years of this century the social or economic casualty had nowhere to turn for help except inadequate charity or a harsh Poor Law. In a world which believed that every man was the master of his own destiny, poverty was not so much a misfortune as a crime, and had to be treated as such; and any assistance given from public funds was deliberately made unpleasant enough to deter anybody from seeking it unless he was at the last gasp. Since then public opinion has undergone a revolutionary change. More knowledge of the working of the socio-economic organisation has made us realise how limited in many ways is man's control of his life and fortune. In this modern world of highly specialised mass production dependent on an intricate network of commercial relationships, the individual citizen is often enough more the victim of circumstances than the arbiter of his own fate, and should not be abandoned to suffer alone the consequences of events over which he has no control. Since the passing of the Old Age Pensions Act in 1908 we have been evolving a system of social security which expresses the partnership between society and individual and which provides for basic needs in a way that maintains the self respect and independence of the individual citizen. Until recently there had been no opportunity to survey the system as a whole and determine whether it achieved its objectives in the soundest manner. Each service had grown up separately from the others, sometimes learning from their experience but, very often, going its own way along a path that had been settled more by the accident of the moment of its birth than by any rationally devised technique. Nearly forty years of trial and error had, therefore, resulted in a body of social provision which, valuable as it undoubtedly was, left much to be desired, both in adequacy and method, and a thorough overhaul was seen to be necessary. During the last few years there have been passed a number of Acts, of which the National Assistance Bill is the last, which, together, carry out this reorganisation. The Family Allowances Act is already in operation, the National Insurance Act, the National Insurance (Industrial Injuries) Act, and the National Health Services Act come into force this year. Together, they ensure that, in addition to the provision of a health

service by which every member of the community can be sure of whatever medical attention he requires, practically everybody is guaranteed a minimum income sufficient to provide for the basic needs of the family during old age, sickness, unemployment, widowhood and orphanhood, irrespective of his own resources and as a statutory right. For the vast majority of the population these measures will be enough to remove altogether the fear of the future; but no large system establishing routine benefits under routine conditions, however well devised or administered it may be, can meet all the varied needs of individuals in widely differing circumstances and it is necessary, therefore, to provide for a type of assistance that is more individualised. This is the aim of the National Assistance Bill. It makes provision for comprehensive services falling into two main groups:—

(1) National Assistance taking the form of financial aid to those who are in need and whose needs are not met by National Insurance or from any other source. This new service, which will be a function of central government, paid for out of national funds, will take the place of unemployment assistance, supplementary pensions, outdoor relief under the Poor Law and assistance given at present by local authorities to the blind or those under treatment for tuberculosis. In short, it means that the relief of destitution becomes entirely a national charge and the old Poor Law completely disappears.

(2) Residential accommodation for the aged, the infirm and others who require care and attention, with special welfare services for the handicapped, such as the blind, deaf and crippled. This will be the responsibility of the local authority, whose duty it will thus become to devise schemes for meeting the needs of special groups or persons in special circumstances. It is the aim of the Bill that the old type of accommodation—the poor law institution—shall disappear and that in its place shall be set up small hostels in which those who are unable or unwilling to live in their own homes may receive the care and attention that their particular circumstances demand.

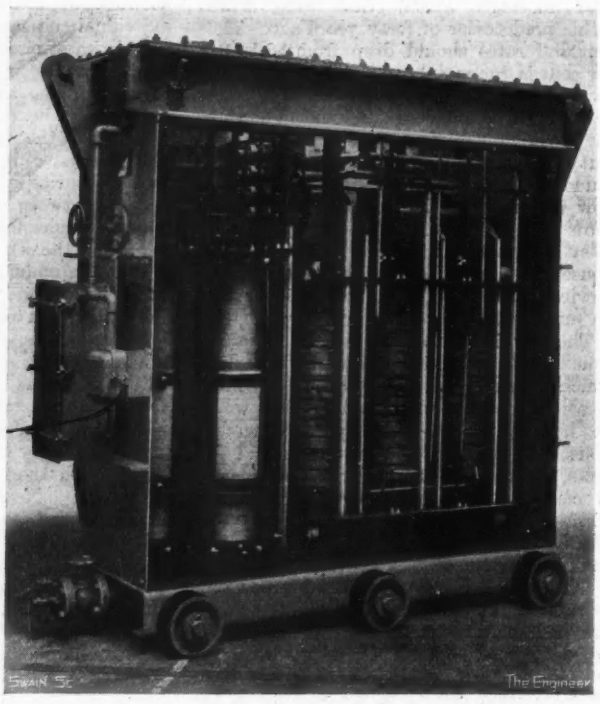
The rounding off of the social services schemes by this Bill completes a system of social provision of which the country can justly be proud. No other country has been so bold in its plans nor has given such clear expression to its strong sense of communal responsibility. The test is in the future. When the ghost of undeserved poverty has been laid and each individual knows that the community is his guarantor of a decent standard of living will the restrictions on productivity which remain as the survivals of an unhappier age be lifted so that we have a larger whole to distribute as well as a more equitable method of distribution?

Electrical Engineering in 1947

No. II—(*Continued from page 9, January 2nd*)

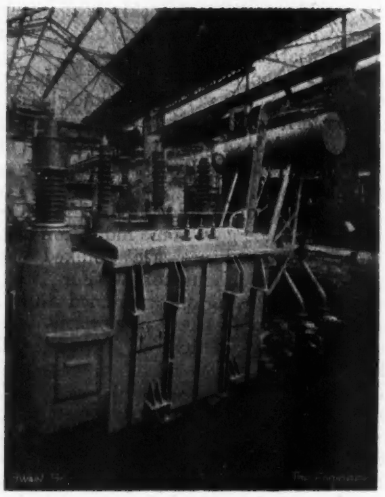
Hydro-Electric Plant

GROWING interest in hydro-electric developments was reflected in the large number of orders placed with British manufacturers for the supply of generating plant at home and abroad. Among the important contracts placed by the North of Scotland Hydro-Eectric Board was one for the complete generating plant for the Loch Luichart power station, comprising two 16,000 h.p. Francis turbines, coupled to two 10,000-kW vertical shaft alternators. The machinery, complete with auxiliary plant, will be supplied by Bruce Peebles and Co., Ltd,. and will be a duplicate of the equipment now under construction for the Grudie Bridge station of the Loch Fannich scheme in the same area. Another contract placed by the Board involved the Mullardoch-Fasnakyle-Affric project in Ross-shire, for which the English Electric Company, Ltd,. will build three 33,000 h.p., 375 r.p.m. vertical reaction water turbines for a 490ft head, with the 22,000-kW alternators generating at 11kV. The same company received an order for a 56,000 h.p. vertical unit, which is to be installed in Clachan power station on Loch Fyne, as part of the Glen Shira project. This reaction turbine will be suitable for a head of 897ft and will drive a 40,000-kW alternator at 428 r.p.m.



500-kVA Moving Coil Regulator Transformer

Of the many export orders two deserve mention. During 1947 Hidro-Electrica Espanola placed a comprehensive contract with the English Electric Company for the equipment of a power station at Cofrentes, on the River Jucar, near Valencia. The plant will comprise intake gates, pipe-lines, water turbine sets, switchgear and transformers. Three 56,000 h.p. vertical reaction turbines for 136m head will be supplied, complete with relief valves and straight flow main valves. The three 36,000-kW alternators will generate at 13·8kV, 50 cycles, running at 300 r.p.m. Another interesting overseas order involved two large horizontal water-wheel alternators for the Abjora power station of the Vestfold Power Supply Company, Norway. These machines are to be built and installed by the British Thomson-Houston Company, Ltd., and will be rated at 35,000 kVA, generating at 11kV, 3-phase, 50 cycles, 500 r.p.m.



Fully Insulated Transformer with On-Load Tap Change Gear

High-Voltage Transmission

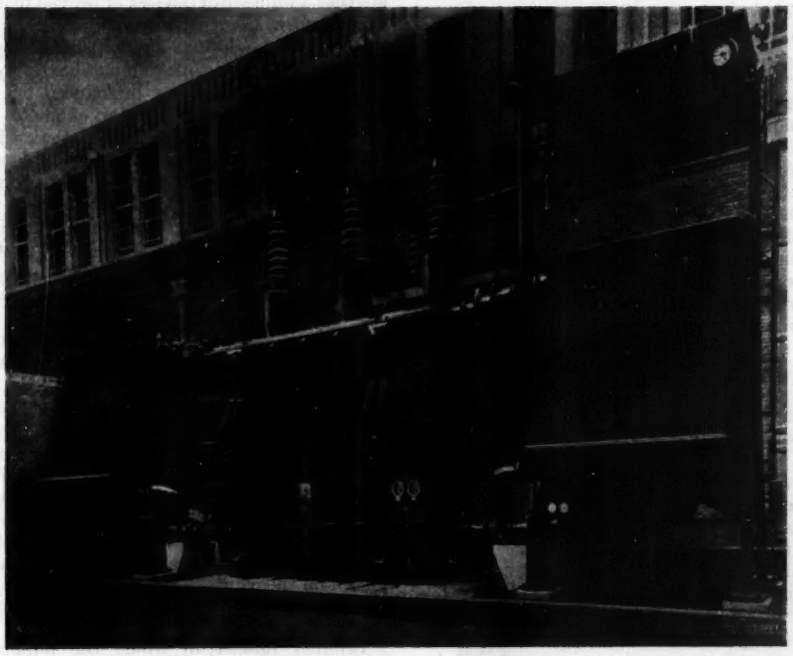
Since we lack space to do full justice to the subject of progress in the transmission of electrical energy we cannot do better than make a brief reference to recent developments in Sweden, which were the subject of an interesting lecture given by Dr. W. Borgquist before the Transmission Section of the Institution of Electrical Engineers in May, 1947.

Sweden epitomises many of the problems that face the transmission engineer, for the main centres of population are concentrated in the south and depend for power upon the hydro-electric resources of northern Sweden, several hundred miles away. At present some 3500 million units are transmitted annually from the north to the south and, when the country's water power is fully utilised, it is estimated that the annual transfer of power will be in the region of 18,000 million units, representing a load of some 3,000,000kW transmitted over an average distance of 450 miles. In his lecture, Dr. Borgquist discussed the limitations of the existing 220-kV and 132-kV systems for the transmission of such large blocks of power as are now envisaged. He indicated the progress made with high-voltage d.c. transmission, and gave some of the reasons for the decision to use 380-kV a.c. transmission for the backbone of the projected system.

The new 380-kV, 3-phase line from Harspranget to Hallsberg will consist of two 300-mile sections linked at Midskog,

at which point there will be an interconnection to the 220-kV Indalsälven power system, providing for an intake of 150,000kW. In view of the difficulties of building transformers with insulated neutrals for use with arc suppression coils at this voltage, the 380-kV system will be solidly earthed. The single line will consist of two conductors per phase, each with an outside diameter of 1·25in, the cross section being made up of 0·11 square inch of steel and 0·81 square inch of aluminium. The conductors will be horizontally spaced, and suspended from 11ft insulator strings made up of twenty-three American type 5¾in units or twenty Swedish type 6¼in units. Normally, the span length will be 1100ft, the towers being built up of welded sections, galvanised and bolted together. The line will be provided with two 0·11 square inch steel earth cables, so disposed as to give a shielding angle of 24 deg. To achieve the low tower footing resistance which is necessary for effective lightning protection elaborate earthing devices will be employed, consisting of cables buried radially at the foot of each tower.

Shunt reactors will be installed at Harspranget, Midskog and Hallsberg, to compensate for the capacity currents in the line corresponding to 250,000kVA at 380kV. At Midskog provision will also be made for phase shift between the 380-kV and 220-kV systems, allowing for a suitable division of load between the two systems.



65,000-KVA TRANSFORMER AT HAMS HALL

TRANSFORMERS

With transformers of all sizes, as with generators, the main emphasis during 1947 was on increased production to meet the unprecedented demands for the home market as well as for export. Although conditions such as these are not generally conducive to technical development, some advances were made. For example, the "stress-control" method of design, employed by Ferranti, Ltd., to give transformer windings increased strength against lighting surges, was developed and extended to embrace a wider range of kVA ratings. The moving-coil regulating transformer is another Ferranti development which attracted increased interest. In this equipment a moving coil regulator takes the place of the usual on-load tap-change gear in power transformers and provides simple continuously variable voltage control without the use of switches, contactors, &c. An example of this class of regulator incorporated in a 500-kVA, 11-kV transformer is shown in an accompanying engraving, the tank side being removed to show the internal arrangement.

In recent years the growing popularity, especially abroad, of h.v. circuits with Petersen coil operation, necessitating fully insulated transformer windings, has created a demand for suitable on-load tap-change gear. A typical example is illustrated herewith—a 20,000-kVA, 115/10·5-kV, 3-phase Ferranti transformer with fully insulated h.v. on-load tap-change gear covering a 14 per cent range. This gear is mounted at one end of the tank with the series switches installed in an insulated compartment suitably accessible for maintenance and examination. Among the interesting jobs in hand in the same workshops were four 65,000-kVA 3-phase transformers, with a voltage ratio of 240/110-kV, for Finland. These units, the first of their kind for 200kV or over to be ordered in this country, will have fully insulated high tension windings with pressure tests corresponding to a standard rating of 264-kV.

Important contracts were placed with British firms by the State Electricity Commission of Victoria for the provision of transformers for the first 220-kV system to be operated in Australia. The English Electric Company, Ltd., will supply seven 18,000-kVA, single-phase "OFB" transformers for installation at the Commission's power station at Yallourn, together with four 16,666-kVA, single-phase "ON" transformers for the Kiewa No. 4 power station. For the same 220-kV system the British Thomson-Houston Company, Ltd., received an order for two 45,000-kVA transformer banks.

For the home market, interest was generally concentrated, in 1947, upon the production of transformers associated with new generating stations or with extensions to existing stations. Among the large units completed by Hackbridge and Hewittic Electric Company were two of three 65,000 kVA 3-phase, 11·6-kV/146-kV transformers for Hams Hall "B" power station. These "ON/OFB" transformers, one of which is illustrated herewith, are good examples of modern British practice, with separate fan-cooled "A" type radiators and forced oil circulation. The units have a high rating on natural cooling, the fans and oil pumps being brought into operation by a winding temperature device above approximately half load.

This company's 1947 programme included the main and auxiliary transformers for the new Kingston-upon-Thames power station, comprising four three-phase units for a 33/3·5-kV ratio—two of 35,000kVA, and two of 5000kVA—besides a number of smaller units for various auxiliaries. Some of these smaller units embody interesting cooling arrangements. Each transformer is totally enclosed in a tubular tank and is air-cooled by three motor-driven fans, mounted one over each limb, on top of the transformer, so that air is circulated continuously through the windings and returns through the cooling tubes on the tank. Connections to these transformers are taken from the bottom, the l.v. connections passing through the floor to bus-bars in trunking.

Activity in the transformer department of C. A. Parsons and Co., Ltd., reached a new peak in 1947 with orders in hand for forty-five power transformers having outputs between 10,000kVA and 75,000kVA. Production has been increased to meet this demand and a further increase in output is envisaged when current works extensions are completed. Work was in progress on a number of air-cored magnetically shielded reactors including a contract for six single-phase, 24/5-kVA, 11-kV bus-bar reactors—the largest single-phase magnetically shielded units yet manufactured at the Heaton works.

(To be continued)

The British Overseas Airways Corporation

THE annual report and statement of accounts of the British Overseas Airways Corporation, for the year ended March 31, 1947, were published early this week by H.M. Stationery Office (price 9d.). They show a deficit of £8,076,844, the revenue from the year's working being £11,547,513, and the total expenditure £18,805,703, while, in addition, provision of £301,389 had to be made for the redemption of Airways Stock. The report comments that "a large financial deficit has been incurred which the taxpayer must regard as a considerable burden," and says that the main causes of the deficit were the multiplicity of types of uneconomical aircraft which the Corporation had to use; the delay in the delivery of Tudor aircraft, and the consequent changes of plans with their financial repercussions; the scattered and improvised maintenance bases which the Corporation had to use; the deficiencies in route organisation; the development work carried out by the Corporation during the year; and the programme of services in which commercial considerations were often subordinated to the national interest. It is emphasised in the report that all these causes contributed to the losses, the outstanding fact being that with the present types of aircraft, even with a high load factor, receipts barely covered direct operating costs. On many routes, little or no contribution was made to indirect costs and overheads, and consequently increased services merely meant an increased deficit. There is only one conclusion, the report adds, and that is that heavy deficits will inevitably continue until the Corporation has the aircraft and facilities to make it financially self-supporting in a highly competitive international business.

Nationalisation of Railways

By N. JOHNSON, M.I. Loco. E.*

No. II—(*Continued from page 10, January 2nd*)

Functions of the C.M.E.

BROADLY, the existing functions of the railway C.M.E. are to design, construct, maintain and repair rolling stock and mechanical plant generally. In most cases the specialist duties of the electrical engineer also form part of the mechanical engineer's charge, and, of course, there are in addition the one hundred and one questions which arise in connection with staff matters. In some cases the C.M.E.'s responsibility extends to the repair of engines in running sheds, while in others this is the duty of the motive power superintendent. But the C.M.E. is usually responsible for technical practice and the inspection and maintenance of boilers.

In regard to all these functions, the C.M.E. of a railway has hitherto been more or less his own master once the requirements of the operating department have been decided upon relatively to traffic needs. Previous to the grouping of railways into four main systems in 1923, there were, of course, many C.M.E.s, and when the amalgamation occurred each railway proceeded with a policy of standardisation of the various types of locomotives and rolling stock absorbed into the particular system; naturally, the ideas of the C.M.E.'s responsible for each railway system became dominant practice thereon. These ideas, however, continued to be highly individualistic and designs (and particularly in regard to details) which were introduced and proved successful on one line did not necessarily find favour with another, even though it might have been thought that service requirements were much the same. To quote examples might be to invite a torrent of what would now be idle criticism, but it is well known to have been the case. However, each was striving for the highest efficiency in his own way, one laying emphasis on certain design features as providing the answer, whilst others pursued quite divergent policies. Each was in the forefront of his profession, in which many paths often lead to the same goal although each being human, doubtless considered his own product to be the best possible in the circumstances; there was inevitably a keen rivalry which was all to the good. In regard to carriage and wagon stock, the position was also much the same. Admittedly, greater strides had been made in design and the use of modern materials in the few years immediately prior to the out-break of war in 1939 than had been made in the preceding twenty years or so, and this might very well have been due to a process of "digestion," which was necessary after the inauguration of grouping; the time and energies of those responsible for policy, organisation and design were so absorbed by the first two functions that there was little left for the third until the others were settled. The four main railway systems were just about getting into their respective strides when World War II came along and called a halt.

In his Press conference referred to at the beginning of this article Sir Cyril Hurcomb mentioned that the unified system will permit a greater degree of standardisation in the interest of economy, but emphasised that this would not impose "unnecessary uniformity"; "consideration will be given," he said, "to the more widespread use of the best features of each of the individual lines where they can be applied with advantage." Sir Cyril also mentioned that "research and development will continue as hitherto in the various regions, but it will be co-ordinated at a high level and unnecessary duplication will be avoided."

So, with the railways unified into one system from January 1st, presumably the whole "digestive" progress will begin once again. There can, of course, be little criticism of the excellent precepts contained in Sir Cyril's statement; no one could wish for better, and, given time, patience and wholehearted co-operative (and perhaps a strong faith in the innate disinterestedness of human nature), there is no doubt that they can be implemented, but it is in this field that the organisation will be put to a stern test.

The individual policies adopted by C.M.E.s in the past were invariably for good and cogent reasons, and to pronounce judgment for one or the other to be adopted in the interests of standardisation, in the face of often conflicting standpoints and arguments, will call for knowledge of a most comprehensive nature and leadership and tact of a high order.

Those who remember some of the dynamic personalites among the great chiefs of the past might derive a little quiet amusement reflecting on an imaginary scene in which some of them were submitting certain pet ideas to an arbiter on an executive! How, for instance, would Mr. Churchward, as a member of the Railway Executive, have received Mr. Gresley's proposals regarding three-cylinder engines, and with "the 2 and 70 jarring sects" competing as to the merits of independent or conjugated gear for driving the valves for these? Or, it might be fancied, how much longer would the G.W. Railway have had to wait to realise the benefits of high boiler pressure and the adoption of piston valves with long travel and long lap had Mr. Churchward first had to convince some "diehard" member of the Railway Executive of their merits?

Scope for Mechanical Engineers

So far we have discussed the framework in which the mechanical engineer on British railways will have to work in the future. Can anything be ventured regarding the scope of his activities? Not much, it would seem, as this will depend on the delegation of powers to be made by the Executive to the regions. Presumably, for some time to come, very little change will be noticeable. Most programmes now in hand in the various regions will proceed under their original authority and impetus. However, a few remarks are offered in respect of topics which will no doubt merit consideration by the Executive in the near future.

One point of intra-regional organisation on which there is at present a division of opinion and practice is that concerning the responsibility for the maintenance of engines in the running sheds. In one "school," if one may use the term, the C.M.E. turns the engines out of workshops new or repaired and thereafter (except usually for boilers) has practically no responsibility for them until they return to the shops for overhaul again. In another "school" the C.M.E. is responsible for all the repairs carried out in the sheds and for the servicing of the engines, but not for the running staff, who come under the motive power or running superintendent.

The particular practice adopted on each system (region) has been that which the management has thought best suited to the particular circumstances, but in the new set-up, where a member of the Railway Executive is responsible for administration in all the regions, it may be necessary to introduce a uniform practice in this matter. It is a big question, but in the experience of the writer the answer is definitely in favour of the latter system, where the C.M.E. has control of shed repairs.

To British engineers serving overseas it often seemed curious that for one reason or another a number of devices of proved utility in American, Continental and Colonial practice were not adopted on British railways; for instance, self-cleaning smoke-boxes, rocking grates (both recently introduced on the L.M.S.) and electric lighting on engines.

As a generalisation it seemed that while the engines on British lines were splendid machines, a criticism that could be made was that more might have been done to assist the footplate and running shed staff—particularly the latter. Was the reason for this, possibly, the outcome of incorrect allocation of responsibility as between "shops" and "sheds"? In other words, between the C.M.E.'s department and that of the motive power (or running) superintendent? It is recognised, of course, that cost is often an influential factor and imposes a conservatism from which the officer responsible for design would like to escape. The money available may have been required for bigger schemes, such as introducing new types of locomotives or rolling stock and at the expense of adopting modern details on which there was little possibility of demonstrating an adequate return on the capital outlay involved.

Standardisation

Another matter in which the public is interested as well as railwaymen is that of the colour scheme which will be adopted for the painting of coaching stock. To have one colour for all regions of British railways would, it is felt, be a sad mistake. It is to be hoped that any suggestion to make it so would be ruled out as falling in Sir Cyril Hurcomb's category of "unnecessary uniformity." Each region should have its own livery. Apart from its psychological value, it would be of practical advantage also; although the Railway Executive will be ultimately responsible for maintaining and operating the rolling stock in all regions, presumably each region will have its own quota to operate and maintain, and if stock on "through" services is of a different colour scheme to that of the region over which it is temporarily running, it would be easily identifiable, both by the railway staff and the public, and will tend to foster some valuable competitive spirit between regions in the matter of maintenance. A decision to paint all stock the same colour scheme would also be likely to result in the use of a cheap pigment of uninteresting appeal to the eye, or of creating a shortage of a more valuable pigment and thus enhancing cost. Standardisation of proprietary fittings and internal decorative and upholstery material, if carried too far, would have the same effect.

It will no doubt be found that there is room for the development of facilities established on one system to supply the needs of what will now be other regions within the

* Lately C.M.E., Burma Railways.

same system; for example, there comes to mind the steelfoundry of Crewe and the steel rolling mills possessed by some railways.

Standardisation in regard to types of engines, rolling stock and components is, of course, an obvious field, and one which is outside the range of such an article as this to digress upon. It is, however, submitted that, concerning this question, British railways can hardly do better than by tackling the matter on the lines developed in India and referred to earlier in this article.

Some interchange of staff should have a beneficial effect. There are some things which are difficult for a management to introduce into what may be termed a "hostile labour climate," which can be done through propaganda by enlightened staff transferred from another region.

The protagonist of nationalisation in justification of his view has always preached the economies that are to be gained thereby. As company-owned concerns, however, the railways have been efficiently managed in the past and are not likely to have adopted policies that could be considered extravagant or capable of much in the way of financial retrenchment.

The possibility of some savings through unification will doubtless be pursued by mechanical engineers as zealously as in the past, but it is doubtful if the mechanical branch affords a great field for any significant achievement in this respect. Improvements are, of course, always possible through the standardisation of rolling stock and duplicate parts and as rationalisation of facilities for production and distribution is effected, but as the existing railway systems already each possess, and are large enough to require, workshops and depots of a size substantial enough to justify the cost of existing overheads in respect of control and supervision, they are hardly susceptible to further major amalgamation. Hence the possibility of any significant economy from that source is not obvious.

The numbers of engines and rolling stock of any one class, it is submitted, are, in general, sufficient to justify efficient methods being employed in the production and stocking of the necessary spares, and, if this is the case, the possibilities to be surveyed would seemingly yield results more in the direction of simplification and of economy of effort rather than that of substantial financial saving.

Nationalisation and Enterprise

In the past the railway mechanical engineers have achieved much by their enterprise, invention and perseverance. Will similar advances continue under the new *régime*? Many authoritative writers who have studied the subject deeply have sounded notes of warning in this respect and have given chapter and verse to show that those virtues do not flourish under State ownership, not only in connection with railways, but in commercial or industrial undertakings generally. One acknowledged authority once declared that in all the history of railway development it has been private companies which have led the way and State systems which have brought up the rear. "It will be difficult," says Acworth in "State Railway Ownership," "to point to a single important invention or improvement (except possibly the 'Schmidt' superheater), the introduction of which is owed to a State railway."

The separate causes of such a state of affairs may be numerous, but are invariably traceable as being the outcome of political influences. The experience of other countries indicates that it is perhaps impracticable to separate nationalisation from politics, and yet such association must be a serious menace to the necessary principle of operating an industry like railways on commercial lines. As Cox, in "The Failure of State Railways," puts it: "The essential defect of the State ownership of railways is that at any moment the politician can treat questions of railway management or development, not from the point of view of sound commercial principles, but as an instrument for buying votes for his party."

However, in Britain we may take comfort from the fact that in the past British railways have led the world in many aspects of railway enterprise, and it is to be hoped that the damning indictments of the effects of State ownership quoted above will not apply to the future of British railways. There is no good reason why British railways should not continue to produce men of outstanding ability and with the courage of their convictions, as they have done in the past, and also, as in the past, there should be room for more than one such man at any time and in any branch of railway work; but if progress on railways is not to suffer, such men, if they are but Regional Officers and not members of the Executive, will need to have greater scope, and there must be more give and take than seems to be envisaged in an organisation in which "instruction, guidance and leadership" will proceed from one authority only—the Executive—which in such case would surely need to be composed of supermen.

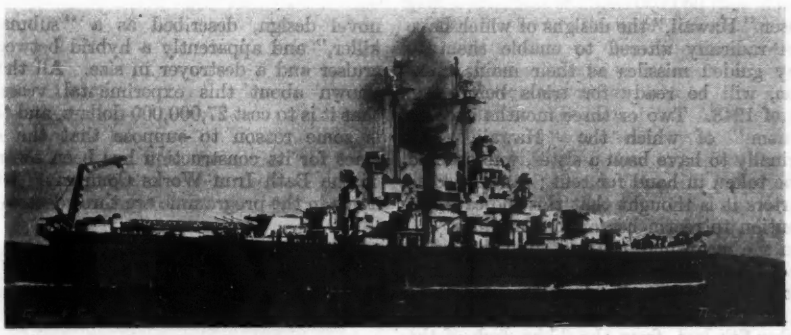
Naval Construction in 1947

By FRANCIS McMURTRIE, A.I.N.A.

No. II—(*Continued from page 19, January 2nd*)

OF the various Dominions maintaining sea forces, only the Royal Australian Navy has so far introduced a post-war programme of construction. This is to include two light fleet aircraft carriers (which it is understood will be acquired from the Royal Navy next autumn and in 1949 respectively), and four destroyers of a new type. The latter may possibly proved to be units of the "Daring" class, described in the preceding article. Two frigates, the "Barcoo" and "Lachlan," and a sloop, the "Warrego," have been adapted for surveying service, though their armaments have been retained in order that they may also be used for gunnery training on occasions. Three tenders of M.F.V. type, named "Brolga," "Jabiru" and "Tallarook," are employed in conjunction with these ships, enabling work to be carried on more expeditiously in shallow waters.

Little further progress appears to have been made with the aircraft carrier "Magnificent," completing for the Royal Canadian Navy at the Belfast yard of Harland and Wolff, Ltd. Two old destroyers, the "Gatineau" and "Qu'appelle," have been scrapped, together with nine frigates and two fleet minesweepers. Two corvettes which would otherwise have gone for disposal have been converted for special duties, the "Sackville" becoming a controlled minelayer, and the "Woodstock," a surveying and meteorological vessel. The training ship, "Sans Peur," originally built by Messrs. Thornycroft in 1933, as the yacht "Trenora," has been sold.



U.S. HEAVY CRUISER "OREGON CITY"

U.S. SUBMARINE "ODAX"

Division of ships of the Royal Indian Navy between India and Pakistan has resulted in the latter obtaining two sloops, two frigates, four fleet minesweepers, two trawlers, four motor minesweepers, and four

motor launches, leaving the former with four sloops, two frigates, a corvette, twelve fleet minesweepers, a surveying vessel, four trawlers, four motor minesweepers, four motor launches and a number of landing craft. It is now proposed that the Royal Indian Navy shall acquire a cruiser (H.M.S. "Achilles") and three destroyers from the Admiralty out of the surplus tonnage available under the post-war reorganisation.

United States Navy

It is expected that the 45,000-ton battleship "Kentucky," and the 27,500-ton battle cruiser "Hawaii," the designs of which have been radically altered to enable them to carry guided missiles as their main armament, will be ready for trials before the end of 1948. Two or three months ago the "Guam," of which the "Hawaii" was originally to have been a sister, was ordered to be taken in hand for refit; and in some quarters it is thought that this indicates an intention to rearm her on similar lines.

French Destroyer "Hoche"

In the meantime, the first guided missile, stated to resemble the German "V 2" in its main features, has been launched from an American warship. This was on September 6th last, from the flight deck of the 45,000-ton carrier "Midway." Though the rocket fell into the sea at a distance of only six miles from the ship, this experimental exercise is believed to have taught some useful lessons.

Two old battleships, the "New Mexico" and "Idaho," of 33,400 tons, were sold for scrap last summer, leaving fifteen ships of this category on the effective list, without including the "Kentucky." Two new aircraft carriers passed into service during 1947; these were the "Coral Sea," third unit of the 45,000-ton "Midway" type, and the "Wright," a light fleet carrier of 14,500 tons. This leaves outstanding the "Oriskany," last ship of the 27,100-ton "Essex" class. In August, 1946, work on her was ordered to be suspended for twelve months, though presumably it has now been resumed.

Only three of the heavy cruisers of the "Des Moines" class, of 17,000 tons, are to be completed, the contract for the construction of the fourth ship, the "Dallas," having been cancelled. All three of the surviving units are in the water, one having been launched in 1946 and two in 1947. They are notable in that their entire armament is automatic. This applies also, it seems, to the light cruisers "Worcester" and "Roanoke," of 14,700 tons, both of which went afloat during the past year.

Three heavy cruisers of the "Oregon City" class are now in service, and a fourth, the "Northampton," is under construction. Eight older cruisers have been stricken from the list. These include the "St. Louis," which it is proposed to transfer to the Peruvian flag; the "Boise," to go to Chile; and the "Nashville" and "Phoenix," destined to join the Brazilian Navy. Actual dates of transfer have not so far been announced.

The programme of new construction for 1947–48 is a modest one in comparison with those of the war period. Most conspicuous of the ships authorised is one of an entirely novel design, described as a "submarine killer," and apparently a hybrid between a cruiser and a destroyer in size. All that is known about this experimental vessel is that it is to cost 27,000,000 dollars, and there is some reason to suppose that the contract for its construction has been awarded to the Bath Iron Works Company. Other items in the programme are three destroyers, apparently of a new type, and two submarines of 2000 tons, the "Tang" and "Trigger." If unofficial reports are to be credited, the latter will have hydrogen-peroxide motors for underwater propulsion, expected to give a speed of 25 knots when submerged. Various other novel features, introduced as the result of a study of German and Japanese designs, and incorporating all the benefits of war experience, are to be embodied in these submarines.

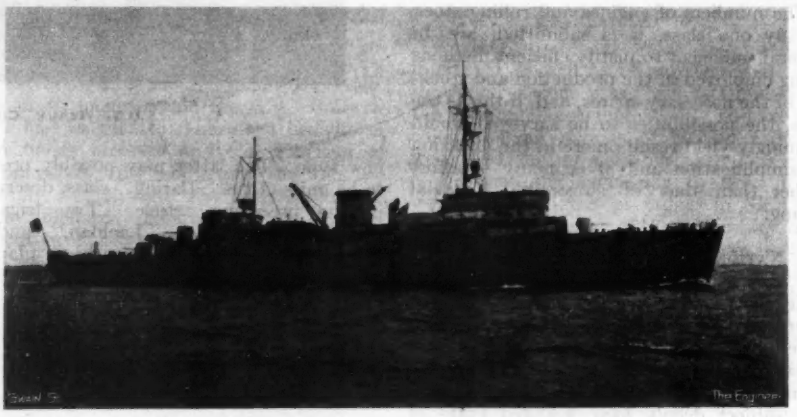
Several of the submarines of the "Corsair" class, which were nearing completion, have undergone radical alteration; as will be seen from the accompanying illustration of the "Odax," this has made a noticeable difference in their appearance. Practically all U.S. submarines in commission now possess a standardised armament of two 5in (25 calibre) and two 40mm guns, in addition to their torpedo tubes. Eighty have been or are being equipped with breathing apparatus based on the German "schnorkel" equipment.

Current estimates also make provision for the fitting out of two submarines for troop carrying, one for cargo carrying and one as a picket vessel, all for experimental operation in the Arctic. Names of the particular units selected for this purpose have still to be released.

Further modifications have taken place in the destroyers of the "Gearing" class. The majority have had the after group of torpedo tubes replaced by a quadruple 40mm mounting; this has also been done in most of the "Allen M. Sumner" class, of slightly earlier date. Other units of the "Gearing" class have had all their tubes removed and the rig modified to facilitate employment as "radar picket" vessels. Construction of the last nine ships of the class was suspended for a considerable time, presumably for modifications to be made in the design. It is said they will be completed as escort destroyers. Two others, the "Abner Read" and "Hoel" were cancelled altogether.

Twelve destroyers of the "Fletcher" class are undergoing alteration in order that they may be reclassified as escort destroyers. Of the many built for this purpose during the war (known as "DE's"), 227 remain in service.

Five ex-Japanese destroyers taken over are named "Hanazuki," "Kaba," "Kaki," "Kashi," "Keyaki," and "Otake." It is expected that they will be expended as targets, as in the case of surrendered German submarines. Three minelayers, three minesweepers, a submarine chaser, two transports, and seventeen escort vessels also fell to the United States Navy as its share of Japanese tonnage.



French Submarine Depot Ship "Gustave Zede"

It would seem that the decision to build no more motor torpedo boats has been modified to some extent, since it is reported that two of experimental type were ordered from the Electric Boat Company at Bayonne, N.J., and two from the Annapolis Yacht Yard during 1947.

Though her reconstruction has not yet been completed, some particulars of the revised armament of the "Mississippi," in her new rôle as gunnery training ship, have been published. Only one of her four triple 14in turrets is being retained; in addition she will mount one 6in, four 5in,

54 calibre, in twin mounts, a number of the new 3in, 50 calibre, of the latest mark, and space for guided missile projectors.

Two cargo ships, the "Pamina" and "Renate," have been fitted out as surveying vessels; the vehicle-landing ship, "Montauk," has reverted to her original duty as an anti-submarine netlayer, and two fleet tugs, the "Yurok" and "Yustaga," have been equipped as submarine rescue vessels and renamed "Bluebird" and "Petrel," respectively.

A new type of landing ship, "LST 1153," has been completed at Boston naval shipyard. Of 6000 tons' displacement, with a main armament of two 5in guns, this ship is propelled by geared turbines of 6000 s.h.p., designed for a speed of 14 knots. She can carry four small landing craft and in comparison with earlier types has increased troop accommodation, greater tank, vehicle and cargo capacity, and improved arrangements for discharge.

France

Financial stringency has interfered to a serious extent with plans for the rehabilitation of the French Navy. A proposal to build an aircraft carrier of 16,700 tons, with a speed of 32 knots, at the Penhoet yard, St. Nazaire, has had to be shelved for the time being. Machinery built for the abandoned carrier "Joffre," of 115,000 s.h.p., ordered before the war, was to have been utilised for this new ship.

Construction of the 8000-ton cruiser, "De Grasse," laid down at Lorient in 1938, which was renamed in 1946, was suspended again last August for lack of funds. Reconstruction of the damaged hull of the large destroyer, "Albatross," is now proceeding on a less ambitious plan. Her boiler power is being reduced by half, bringing the speed down to 25 knots. She will thus need only two funnels instead of the original four. It is intended to employ her as an experimental gunnery vessel and for training duties. The five 610-ton torpedo boats of the "Melpomene" class have all been laid up and are expected to be discarded.

Three submarines, seven corvettes and twenty-two motor minesweepers, which were on loan from the Royal Navy, have been returned, but a number of ex-German vessels have been acquired from the United States share of surrendered tonnage. Some of these may be utilised to provide spare parts for ships already in service. For example, spare parts of "Z 39" might be valuable for refitting the "Hoche" and "Marceau," sister ships taken over in 1946; others will be commissioned under the Tricolour, e.g., the torpilleur "Dompaire" (ex- "T 14"), the submarine depot ship "Gustave Zédé" (ex- "Saar"), and aircraft tender "Marcel Le Bihan" (ex- "Greif").

Two obsolete ships, the battleship "Lorraine," dating from 1913, and the aviation transport "Béarn," launched in 1920, have both been relegated to harbour service.

(To be continued)

Coal in 1947

By SIR RICHARD A. S. REDMAYNE, K.C.B.

No. II—*(Continued from page 21, January 2nd)*

Labour and Labour Troubles

THE position in regard to the number of persons employed at the collieries had so improved that by July there were 719,100 wage earners on the colliery books as compared with 699,100 at the end of July, 1946. Part of the increase was due to Poles—not for the first time—entering the mines; more than 5300 were employed by the end of October and a further 386 were in training. It was intimated on November 15th that about 30,000 European volunteer workers were to be recruited for the coal mines during the ensuing twelve months, and that it was proposed also to recruit 10,000 German orphan boys; but, unfortunately, the year has been marred by the number of disagreements, many of them resulting in strikes, the initial cause of the more serious of them being the disturbance resulting from the institution of the five-day week which came into operation on May 5, 1947.

Prior to the disturbances caused by the suggested extension of the working time per diem proposed by the Prime Minister at the end of July to meet the loss of output due to the five-day week, there had been no less than 680 stoppages at the coal mines, involving about 120,000 men in all and a loss of 34,900 working days. Coal mining accounted for more than half of the total number of industrial disputes—in July alone there were sixty-seven disputes in the mines and 27,000 working days were lost.

Why the experiment of the five-day week should have been introduced at a time when the nation was in such dire need of coal—a greater need than perhaps in any other period of its history—is difficult to understand. As *The Times*, in a leading article of August 26th, put it—"the five-shift week in the mines has been shown to be a luxury which the nation cannot afford." Certainly it resulted at first in a small decrease in "absenteeism," but this reduction was not maintained for long. Mr. Ebby Edwards, who is a member of the National Coal Board, speaking on June 3rd last at a gathering of the National Association of Colliery Managers, stated that the cost of the five-day week had meant a potential increase in wages of thirty million pounds and statutory holidays with pay in four million pounds a year.

The most noticeable of the several strikes which took place was that which commenced on August 11th at Grimethorpe colliery, in Yorkshire, and spread to a number of other collieries in the same coalfield. It and other strikes came about in this wise—the loss of output due to the institution of the five-day week was such that it was felt that an extension of working time was incumbent if the nation was to have its requisite supply of coal, and so on July 30th the Prime Minister asked the miners of Britain to work an extra half-hour a day, i.e., 2½ hours in the five-day week. It was considered that this would give an additional 6,000,000 tons by the end of the year, so that the Government's minimum target of 200,000,000 tons of coal would be exceeded by about 1,000,000 tons. The miners' leaders undertook, as a matter of urgency, to examine the suggestion, and protracted and unfruitful negotiations took place between them and the Coal Board, with the Government intervening; but by the end of August they had arrived at a deadlock. However, eventually, an agreement was come to by which it was left to the various mining districts to decide whether they would work (*a*) on two alternate Saturdays in the month an 8½-hour shift, or (*b*) half-an-hour a day extra on five days a week.

The stoppage at Grimethorpe arose through the refusal of 132 men working in the Melton Field seam to agree to an extension of their "stint" by 2ft—a "stint" being the extent of the coal face to be worked by an individual or group of individuals, in this case 21ft—the presumption being that the 23ft could easily be worked in the extended shift, the men being, of course, paid for the extra coal gotten. The Melton Field seam has an average thickness of 3ft 9in, and the face men had been getting 13½ tons per man per shift of 7½ hours, the rate of payment being 2s. 2d. per ton. The Grimethorpe men considered that the conditions obtaining at the colliery were not properly understood by those imposing the extension of the stint. However, eventually it was agreed that a fact-finding committee of three expert mine workers should examine all relevant matters as soon as the men returned to work and report thereon, and that if their report disclosed that the procedure for assessing the task of the Grimethorpe men was in any respect imperfect, the Coal Board and the Union would consult together as to the best way of remedying the defect. The committee reported on September 29th that the extra 2ft stint could not be worked at two of the four faces in the Melton Field seam, and the report was approved by the Grimethorpe men on October 20th. This strike, involving at its peak 54 collieries and 55,000 miners, lasted until September 15th, with a total loss of about 600,000 tons of coal.

It would seem to the unprejudiced onlooker that the trouble at Grimethorpe points to one of the disadvantages inherent in centralisation of administration, lack of local knowledge, and to the advisability of leaving to those on the spot the manner of imposition and work of negotiation in regard to the application of broad lines of policy laid down by the Coal Board. It points, too, to the futility of endeavouring to impose uniformity of application in a national scheme.

Other sporadic strikes or threats of striking, occurred throughout the country, to which brief notice may be made. On September 10th, 6000 overmen, deputies and shot-firers in the Yorkshire field threatened strike action, being concerned with grievances about the working of the five-day week, but eventually withdrew their notices.

I mention this latter incident as it is, I believe, the first time in the history of the coal-mining industry that a threat of strike action has emanated from this body of men, who are to the industry what the non-commissioned officer is to the Army—its backbone.

On October 20th, 4500 miners were thrown idle in the Lanarkshire coalfield where oncast workers (datalers) were dissatisfied with the progress made in settling their claim for higher wages, and by October 22nd the disturbance had spread to 67 pits, 21,345 miners being rendered idle, involving a daily loss of output of 32,447 tons of coal. By October 23rd, 83 pits had stopped work, the number of men rendered idle amounting to 24,892, with a daily loss in production of 40,697 tons. Before the strike was settled and the men returned to work, the loss in production is estimated to have been 145,000 tons.

Other and minor disturbances occurred to which exigencies of space do not permit of reference. There is much to support Mr. F. Vernon Pearson's statement in his letter to *The Times* of September 10th under the title "Incentives in Industry":

"From my own experience I am convinced that improved industrial relations, even more than increased mechanisation, are the key to the 1947 battle of production, and, further, that this is equally true of privately and publicly owned industry." It is well to learn, therefore, that at every pit the N.C.B. has established consultative machinery for the settlement of pit disputes.

Miners' wages had reached a point at which, on the average, they were higher than ever before in the history of the industry, the average earnings for male adults, in comparison with those of 1939, being as follows :—

Per man-shift worked	Excluding all allowances in kind	Including value of allowances in kind
	£ s. d.	£ s. d.
April to June, 1939 ...	12 6	19 11
April to June, 1947 ...	1 8 6	1 9 9
Per week :		
April to June, 1939 ...	3 3 3	3 5 4
April to June, 1947 ...	6 16 10	7 2 10

In the late autumn the miners' leaders put forward a claim for a £1 a week increase on their basic or minimum wage of £5 for underground men and £4 10s. for surface men. The N.C.B., supported by all the Divisional Coal Board Chairmen, presented a counter-proposal of 10s. But it was agreed on November 14th to accept 15s. and 10s. respectively, and appropriate increases for youths, these increases to be retrospective so as to become operative in the first full pay week in November. It is to be hoped that the effect of the enhanced minimum wage rate will not be detrimental to productive effort. This advance in wages will put up the price of coal by 1s. 4d. per ton. In 1932 wages accounted for nearly 62 per cent of the cost of production; the proportion at the present time will be nearer 70 per cent.

Accidents and Colliery Disasters

After a long period of comparative freedom from major colliery disasters—an exemption due, one is forced to conclude, to our greater knowledge concerning explosions and the part played in their incidence by coal dust and the preventive measures, chiefly in the use of stone dust in the adulteration of the coal dust on the roads and at the face of the mine (with which preventive the name of the late Sir William Garforth will for ever be honourably associated)—we hoped that the era of widespread colliery explosions had passed; but there occurred during the past year two such disasters, due to the ignition of fire-damp, the one at Burngrange, an oil shale mine in Midlothian, on January 10th, by which fifteen persons lost their lives, and the other at Whitehaven "William" colliery, in Cumberland, on August 15th, which resulted in the loss of 104 lives.

In the first-mentioned case, fire-damp was ignited by an open acetylene cap lamp near the waste edge close to the face, and was followed almost immediately by a second fire-damp explosion which spread along the face to adjacent places, this explosion being succeeded by a series of lighter explosions and the burning of gas along the waste edge causing flame to persist and so setting up fires in five separate places. The report of the Chief Inspector of Mines on this explosion recommends, among other things, that only locked safety lamps and "permitted" explosive should be used in the mine in future.

Whitehaven has an unfortunate record in regard to liability to colliery explosions. In 1910 an explosion occurred there by which 136 persons lost their lives, the cause of which the present writer, in his then capacity of H.M. Chief Inspector of Mines, had to investigate. In 1922 another took place by which thirty-nine persons lost their lives. And in 1927 yet another occurred, at shift-changing time, otherwise the death-roll would have been heavier as the blast wrecked the pit. Two months later, when the pit was opened, four more explosions took place, thirteen of the inspecting party being killed, inclusive of the general manager and two Government Inspectors. Again, in 1931, yet another explosion occurred, resulting in twenty-seven deaths.

In regard to the disaster of last August, the technical experts who gave evidence at the inquiry were unanimous in regard to the cause, namely, that it originated in the firing of a charge of sheathed "permitted" explosive placed in a shot-hole drilled in the roof and directed towards the waste. The shot-hole passed through a roof break, and the inner end of the hole made contact with or was in very close proximity to a bed-separation cavity containing inflammable gas, which was continuous with a larger accumulation of explosive gas in the inaccessible waste. The Chief Inspector, in his very interesting "Interim Report" on the disaster, recommends until such time as the present statutory requirements in relation to shot-firing have been suitably amended or extended in all coal mines the roof of longwall faces of which are in close proximity to inaccessible wastes containing or likely to contain inflammable gas, the advisability of prohibiting the practice of shot-firing by explosives and the adoption of other means for doing the work required, and, further, the keeping of the wastes as clear as possible from dangerous accumulations of fire-damp. "To do this, effective roof control measures should first be taken to regulate and, if possible, reduce the rate of emission of fire-damp from the coal seam and surrounding strata. Thereafter, the wastes should either be packed tightly and completely . . . or the fire-damp should be constantly drained from the waste by diverting part of the ventilating current through appropriate cundies, small openings or pipes suitably disposed in the wastes or packs." He also advises the strengthening of the system of support and roof control not only so as to prevent as far as practicable the formation of roof breaks and bed-separation cavities, but so as to encourage the roof to break down regularly in the wastes when the temporary supports are withdrawn.

Appalling as is the waste of life through colliery explosions, yet the number of lives annually lost through falls of roof and sides exceeds the toll due to explosions of fire-damp and of coal dust. The method of support has varied little in principle in the history of mining, and largely consists in propping with wooden or steel supports. Of recent years, however, a good deal of research work has been carried out on strata control in coal mines, and the experiments initiated by Von Karman, of Gottingen, some years ago might with advantage be further pursued. Tests underground with a method of control based on the experiments of Von Karman and others are at present being carried out in Great Britain, the results of which will be awaited with interest, for, should the tests prove successful, propping of the roof would be largely abrogated in favour of strata control with, consequently, a great saving in the importation of pit timber, the value of which in some years attains to over £6,000,000 sterling. Many years elapsed before a preventive to the occurrence of explosions of coal dust in mines was discovered by the use of stone dust as an adulterant. Is it too much to hope that research will reveal an equally simple means of obviating accidents from falls of ground?

Developments in Mining Technique

"Pneumatic" solid stowage of longwall wastes known in European coalfields for some time was practised for the first time in Britain at Llanharan colliery in South Wales in 1937, and about the same time at a group of collieries in Scotland, and, a few years later, in the Barnsley seam at Bullcroft colliery, near Doncaster. The solid packing of wastes is, of course, adopted as a preventive, or, at any rate, a deterrent, of spontaneous combustion and of subsidence.

In South Wales it was not until 1943 that intensive experimental application was commenced at Penallta colliery. Here the stowing material is dirt, of a size ranging from 0in to 3in, derived from a Baum washery, 64 tons per hour being available for stowing. Six pneumatic machines are in use, namely, Beien V.H.20, but the use of V.H. 70, which has a normal capacity of 90 tons per hour through a 6in column, was under consideration last May. An excellent paper on the application of this method at Bullcroft appeared in Part 3 of Vol. 105, "Transactions," Institute of Mining Engineers, and as applied in South Wales, in a paper read before the South Wales Institute of Engineers at Cardiff, on February 20th, last.

With regard to mechanisation at the coal face, the most novel feature during the past year has been the trial of a German coal plough at a specially selected coal face at a British colliery. Preliminary results are encouraging and, we are informed, improving as the men become accustomed to its operation.

Power-loading of coal into the tubs at the face, which has of late years been so largely developed in the coal mines of U.S.A., in which the natural conditions are so favourable to its application, has, during the last year or two, seen wider application at British collieries, where the conditions are nothing like so suited to its application. Some interesting information on the subject was forthcoming at the World Power Conference, held at The Hague in September last. We learned that mechanically loaded bituminous coal in U.S.A. constituted 45·5 per cent of the total output in 1945, opencast and underground. Underground alone the figure was 35·5 per cent, and with anthracite (underground), 25·4 per cent of the total anthracite production.

Greater use of machines is, it was stated, primarily responsible for the increase in production from 4·47 tons per manshift in 1923 to 5·78 tons per manshift in 1945 in the bituminous coal industry of U.S.A., and from 2·4 tons to 2·79 tons per manshift in the anthracite industry, where natural conditions are less favourable. But, though we are far behind U.S.A. in power loading, owing to our thinner seams and our prevalent system of mine layout precluding the adoption of the American type of machine, we have made and are making considerable progress, as witness, during the past year, the expansion in the use of the Meco-Moore cutter-loader, the Huwood and the Shelton power loaders. The A. B. Meco-Moore cutter-loader for longwall working is now so designed as to be applicable in seams down to 3ft in thickness. An interesting account of the application of this machine at Gresford colliery, where the seam worked is from 8ft to 8ft 6in thick, was given at the meeting of the Manchester Geological and Mining Society on January 21st last. The Huwood being

only 1ft 10in high, can be used to load coal in seams as thin as 2ft 3in to 2ft 6in. Although the mechanical loading of coal underground is still in its infancy in British collieries, about 100,000 tons a week or between 3 per cent and 4 per cent of the nation's output is being now so loaded at the coal face.

As a record of what has been accomplished and what yet was in progress under a system of amalgamation short of nationalisation, may be instanced the case of the group of collieries known as the Manchester Collieries, Ltd., as referred to by Mr. M. K. Burrows in his speech at the annual meeting of that combine on September 23rd last. "The percentage of coal carried by conveyors underground increased from 12·2 per cent to 95·5 per cent and the percentage of coal cut by machine from 17·1 per cent to 97·8 per cent between 1930 and 1946 The aggregate of electric power used underground had more than doubled and was replacing compressed air at wherever the conditions could be made quite safe."

Possible New Coal Areas

In my Presidential Address to the Institution of Mining and Metallurgy as far back as the year 1916, I drew attention to possible future sources of coal in our island-extensions of existing coalfields, most of which have been proved since the Royal Commission on Coal Supplies reported in 1905. The subject arouses a new attention in view of the future development which the National Coal Board includes in its long term policy. Where will the new pits be sunk ?

The extensions of the Notts and South Yorkshire coalfields are now fairly well known; those of the Warwickshire field have been proved, as also the compass of the Kent field; and geologists are speculating as to the existence of an entirely hidden coalfield in southern England—but this is a matter for future exploration. In respect of the Staffordshire coalfield, West of Birmingham, the area between Wolverhampton and Shifnal will, I think, on boring, show that it contains considerable deposits of coal. Another large and possibly profitable area of Middle Coal Measures is that lying immediately under the Red Rocks to the south-west of Manchester, the accessibility of which depends only on the thickness of the Permo-Triassic cover. This area is, however, complicated by faults and the like disturbances.

Coming south, many borings have been put down round and to the south of London —well into Buckingham—and the underground geology of this area is broadly known. But to the west, viz., the area between London and Bristol, remains unproved.

Whilst it is eminently desirable that further extensions of our coalfields should be defined, and hidden fields, if they exist, be discovered, to replace the dying fields, the Coal Board will, it is presumed, concentrate in the first instance in the sinking of their new pits on the known and proved areas of existing fields.

Efficiency in the Use of Coal

The "Political and Economic Planning" organisation issued a report on British fuel and power industries of 400 pages, dealing with coal, electricity and the supply of gas, which contains many excellent observations and suggestions well worth the serious consideration of Government and others interested in these branches of industry. The most wasteful use of coal lies in the production of heat in the open fire-grate. Probably this affords an efficiency in most cases of not more than 12 per cent, and the domestic field absorbs a large part of our output of coal. If we take into consideration electricity and gas, the consumption of coal for domestic purposes amounts to about 60 million tons per annum—in respect of the use of electricity and gas the efficiency is, of course, much higher than is the case with the open fire-grate.

In the report on domestic fuel policy issued by the Fuel and Power Advisory Council (in Command Paper 6762) there is this comment: "We have shown that our coal is used for domestic heating with a degree of inefficiency which is not so far as we can ascertain even approached by any other country in the world. Quite apart from the resulting high cost to the householder, this inefficiency causes the waste of many millions of tons of our coal reserves per annum. We are using excessive quantities of coal, we are providing inadequate heating in houses, we are pouring out masses of soot and tar into the atmosphere. In our view we cannot afford to maintain our low standard of heating. We cannot afford to continue to depress and destroy the life of our cities by smoke pollution. We cannot afford to waste our limited national coal reserves."

With regard to the great economy which might be effected in the saving in fuel used for domestic purposes, Mr. Shinwell informed the House of Commons on March 13th last that an inter-departmental committee on domestic heating was taking all practicable steps to ensure that solid fuel burning appliances of improved types, which satisfy certain standard performance tests, shall be installed in all new houses, and with reference to district heating he stated, on July 29th, that in conjunction with the Ministries of Health and Works he had appointed a Committee in February, 1946, to make general recommendations on the practicability of district heating and to examine specific proposals put forward by local authorities and other bodies. One of the objects aimed at is to encourage local authorities to consider the application of district heating to their building programmes, schemes approved by the Committee being under consideration at Urmston, Salisbury and Bonnyrigg. In addition, twenty-three other schemes had been submitted by the Committee or were known to be under consideration. Such arrangements should, one would expect, result in a saving of fuel. According to Mr. Shinwell (July 3, 1947), of the staff of his department those engaged full-time in devising or advising and assisting in the application of methods for the more efficient use of fuel numbered 173, including 79 engineers and 25 stoker demonstrators. During the past twelve months the staff had helped industrial undertakings to maintain or increase production with reduced or down-graded supplies of fuel, and consumers had been advised in connection with the design or extension of factories. In addition, assistance had been given in the conversion from coal to oil where this was being carried out, and advice had been given as recounted above to local authorities as to improved fuel burning appliances.

Rivals to Coal

Hitherto there have been only two serious rivals to coal as a means of producing heat, light and power, namely, oil and water power. Coal and oil are rapidly diminishing sources. A new probable source is looming in the distance, namely, the controlled release of energy by nuclear fission, commonly known as atomic power. But the application of this source of power to industrial purposes is a long way off and there is no immediate prospect of its replacing coal as a source of energy, and, in any event, coal will be required, even if supplanted as a source of energy, as the raw material in the manufacture of numerous substances necessary to man. The only known method of using nuclear energy industrially is to use an atomic pile to heat water and generate steam from which electricity would be produced. According to the estimates made by authorities it would appear that electricity so generated would cost at least 25 per cent more than the current price of electricity, and only 12½ per cent of our coal output is used in the generation of electricity.

Obituary

SYDNEY RUPERT DIGHT

Many British marine engineers will learn with deep regret of the death on New Year's Day of Engineer Rear-Admiral Sydney Rupert Dight, at the age of sixty-two. In the 1914–1918 war, Engineer Lieutenant Dight was on the engineering staff of the cruiser "Weymouth," was assistant secretary of the Board of Inventions and Research at the Admiralty and worked on the staff of the Engineer-in-Chief. During this time he initiated the development of the three-drum Admiralty boiler, fitted with a specially designed superheater, arranged so as to give a considerable degree of superheat at all powers. Later, after spending two years at the Royal Naval College at Greenwich as instructor in marine engineering, he was given charge of the construction of the machinery for the propulsion of the aircraft carrier "Furious," of which ship the captain was the late Sir Reginald Henderson, later Controller of the Navy. Between them they developed a technique for the operation of the machinery of an aircraft carrier for the safe take-off and landing of aircraft, which was at that time quite new. It made use of an acceleration recorder which was designed by Commander Dight, which gave a continuous record of the ship's acceleration on the bridge, so facilitating the working out of the operating problems.

In 1928 Commander Dight was made officer in charge of the Admiralty Fuel Experimental Station at Haslar. He retired from that post in 1939 with the rank of rear-admiral. Dight invented a circulation augmentor, which was fitted in many naval boilers.

In 1935 he was awarded the C.B.E. in the Birthday Honours. In 1939 he was appointed to work under the Vice-Chief of Naval Staff on more military duties, in connection with the various uses of oil-fuel in warfare, particularly in the development and use of oil fog for the protection of vital targets against air attack.

He was a valued member of the Institution of Naval Architects and the Institute of Marine Engineers.

In 1946 he spent the summer in Abadan on a mission he undertook as consultant to the Anglo-Iranian Oil Company, to investigate the working and efficiency of shore boiler and power plants. In this work he displayed that feature of his character which will always be associated with him, a meticulous attention to the detail of his task combined with the inate ability to show the man doing the work how best to set about it. He will long be remembered among many of his friends for his pleasing personality, his friendliness, and his pioneer work.

THE ENGINEER

JANUARY 9, 1948

VOL. CLXXXV No. 4798

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NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

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LOCOMOTIVES AND MUSEUMS

OF all the works of the mechanical engineer none has enjoyed greater popularity than the steam locomotive. It began with that great public and fashionable event at Rainhill in 1829, and if it has waned somewhat since locomotives have become boxes on wheels, there is many a true heart that is constant to the engines of the past. Ships of all kinds have, perhaps, run the steam locomotive close, but the electric locomotives and the diesels are mere also-rans, hardly to be spoken of in the same breath with the achievements of the great masters. There still be those who can recall the stately stride of the single wheelers, or who love to dwell upon the elegance of the "Midlands" in the days when chimneys were chimneys, not mere "chaplets on the smokebox." Others will chuckle over the impertinence of the Brighton "terriers," or revive old tales of "Jeannie Deans," and the "Precursors," and the engines that took part in the "Race to the North." But the number of those whose memory carries them happily back to the days and deeds of these worthies grows less and less. They see a new generation arising that is likely to forget these things, and they—supported, happily, by some younger people—plead for the preservation of examples so that the ancients may be honoured in the land of their birth and labours.

As far as preservation in museums is concerned, locomotives are their own worst enemies. They are too big, far too big. They are not alone in that respect, and South Kensington is constantly obliged to refuse exhibits that it would be proud to own because space is lacking. There is a constant competition for a place in the sun, and it must be acknowledged that steam locomotives have not done so badly. There is probably no more illustrious collection the world over than that in the Science Museum. At York there is the excellent museum established by the London and North-Eastern Railway, and, presumably, now national property. It has, amongst a fine array of railway relics of all kinds, several locomotives of historic interest. But it is already overcrowded. The Stephenson Locomotive Society asks in a letter that may be found on another page: "Is it too much to hope that in the country which gave railways to the world, a due appreciation of their unparalleled historical worth could be expressed in the establishment of a *national* collection?" We say with regret that we see no probability of such a collection being established for years to come. To house the engines alone a large building, perhaps a round house, would be needed, and an appropriate site for it would have to be found. But the Society visualises the preservation of other railway relics and that would mean long and large galleries. On that point the Society will rejoice to have the assurance of Sir Cyril Hurcomb—see *The Times*, January 1, 1948—that the British Transport Commission is very sympathetic to the preservation of railway relics and archives. But it looks to their preservation in "convenient centres." It, no doubt, sees that for the present at least a "national collection" is impracticable.

In the meantime, what can be done, first to prevent the scrapping of famous engines, and secondly, to keep their memory green if they must be broken up? For the first, more might be exhibited in stations or railway yards, as "Locomotion No. 1" and the "Derwent" at Bank Top, Darlington; the "Lion," normally at Lime Street, Liverpool; and the "Tiny," at Newton Abbot; as for the second, no machines have been so much modelled as locomotives. We have no manner of doubt that true scale models would be forthcoming for nearly every engine of note. A very representative show can already be found in the Science Museum at South Kensington, and it needs but the co-operation of the B.T.C. to fill in gaps that exist or to keep the collection moving forward with the times. No one will deny for a moment that the "real thing" is better a thousand times than a miniature, however accurate, but a full-scale collection is barely practicable whilst a complete collection of models is far from impracticable. Nevertheless, we welcome the idea of a national museum of railways. The times are against its realisation, but they will change, and a future generation may see a museum worthy of one of the greatest of the many gifts mechanical engineers have given to the world.

EDUCATION AND THE STANDARD OF LIVING

EVER since it came into power our present Government has been encouraging research and development in many fields with an enthusiasm seldom if ever shown by Governments in the past. No doubt this interest in research and development has arisen mainly from a lively recollection of the remarkable achievements of research teams during the war in the development of such things as radar, Fido, Pluto, the atomic bomb, and many other less well-known but very valuable devices. Yet there is a further reason for Governmental interest. Never before these post-war years of economic struggle has it been so forcibly impressed upon the people of this country that there is an intimate connection between the rate at which they produce and the standards at which they live. We are being repeatedly urged to work harder that we may produce more and that our existing standards of life shall not fall. But over a longer term than the short-period economic emergency with which the country is now faced harder work is not the means by which our standards of life can be raised. The level of comfort or even luxury at which we live can be raised only by increasing productivity per man-hour, producing more in less time, so that concurrently we gain both more to enjoy and more leisure in which to enjoy it. Hence has been aroused the interest of a Government, concerned to raise living standards generally, in research and development. For intensive work of that character holds out the hope of improving products and methods of production, of bettering management, of operating transport more efficiently, and making more rapid and certain all means of communication, thus in these and several other ways improving the rate of output without increasing hours of work.

But this research and development work from which so much is expected makes heavy demands upon the intelligence of the nation. In this the twentieth century we have travelled far, indeed, from the days when Egyptian taskmasters thrashed hundreds of slaves into sweating action, that a great temple or a pyramid might be built. That ancient civilisation of the past had perforce to depend for nearly all the work that had to be done upon muscle, animal or human. The bulk of mankind, indeed, was then valued far less for its brain than for its brawn. It was the limitation in the amount of muscle that could be brought to bear that set bounds to man's achievements. How widely different is our modern Western civilisation! The inventions of engineers and more particularly their discovery of the means of generating power from the burning of fuels has relieved man of much of the need for laborious toil. Instead there has been laid upon him the more intelligent task of controlling the machines. The only bounds now upon what man can do are fixed by the limitations of his intelligence. In consequence Western civilisation has become increasingly complex and intricate, demanding for its successful operation an exhibition amongst all classes of higher and higher intelligence. So, in answer to that need, we have seen throughout the nineteenth and on into this twentieth century the advantages of education being extended to every class. That extension has not been granted merely as a favour consequent upon the improved standards of life that the greater productivity of machines has made possible. It has become essential if the best output is to be obtained from improved machinery. Not only has it become necessary to demand a higher standard of education for professional men such as engineers

who direct how machines shall be made and used; not only must engineers seeking the qualification of membership of a major institution now reach defined standards of education equivalent to an engineering degree or in other ways prove the high merit of their attainments; but more is demanded, too, of those in less responsible posts. It is even beginning to be demanded of the skilled hand that he shall reach at least to a matriculation standard in general education. For the skilled workman to-day, adequately to do his job, must be more highly educated than his father. As therefore we strive year by year ever to reach higher standards of living for the many there grows also a demand for better and better education and for higher and higher ability. The maintenance of the living standards of Western civilisation depends upon the use of greater and greater intelligence in its direction. The fact that through the improper use of nuclear power that civilisation might well perish under the impact of atomic bombs gives especial emphasis to the need for intelligence in the use to be made of the increasingly great powers that scientists and engineers are putting in the hands of man.

But in thus making more and more use of the innate intelligence of a people it is by no means upon an inexhaustible fund that we draw. To suppose so would be to confuse intelligence with education. In fact it is very doubtful whether education can have even the slightest influence upon intelligence. It is very much more probable that it can do no more than teach us how best to make use of such brains as we may have inherited. Thus a time can be foreseen when the demand for trained intelligence may far outrun the available supply. But that time is not yet. We are, indeed, at the moment, in this country suffering from a shortage of trained scientists and engineers and of trained minds in many other pursuits. But the shortage seems to arise rather from lack of facilities for training than from any failure in the numbers with minds fit to learn. There is then no reason to suppose that recent educational activities, the raising of the school leaving age, the opening of paths for talent from whatever source to attain the best education the State can provide, and the extension of facilities for education at technical colleges and universities will not for many years to come provide a flow of trained minds reasonably adequate to meet all demands.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

LOCOMOTIVES AND MUSEUMS

SIR,—In taking administrative charge of British Railways on January 1, 1948, the Railway Executive Committee will have come into possession of many items of railway equipment, drawings, and records which are of unique historical value. It is much to be hoped that the responsible officers will see that due care is exercised in deciding what ought to be preserved, for the fate of many irreplaceable items will be placed in their hands. An important example of this exists in the veteran passenger locomotive No. 20002 (old No. 2) of the L.M.S.R., which was built in 1866 and was in continuous service until a few weeks ago. The engine is now standing at Derby, its fate uncertain.

Through the Stephenson Locomotive Society, successful efforts were made to persuade the L.M.S.R. authorities to postpone the breaking-up of this very notable machine; but as the engine has passed now into State ownership, the Society would like to know the feeling of the Railway Executive Committee about the preservation of certain historical items of which this engine is so fine an example. The L.M.S.R. were, indeed, willing to sell the engine at its scrap value to the Stephenson Locomotive Society. The Society, however, is not interested in the mere acquisition of historic locomotives as such; but it is intensely interested in their preservation and permanent exhibition, so that their full significance, in the trend of engineering thought and in the constructional style of their day, can be appreciated by the public. The Society, which is the senior body in this country for the encouragement of an appreciation of railway locomotive history, would be glad to give any help within its power to the Railway Executive in the future, so that the preservation of unique railway relics can be realised.

The time is now fully ripe for the establishment of a national railway museum. An excellent lead in this direction was given by the L.N.E.R. in founding its Museum at York, though this naturally has a preponderance of objects from that line; in any case, the accommodation there is practically filled. In view of the possibility of many items of present railway equipment being discarded through change of ownership, a chance—which will never come again—of preserving them for posterity presents itself. Is it too much to hope that in the country which gave railways to the world, a due appreciation of their unparalleled historical worth could be expressed in the establishment of a *national* collection?

J. M. MASKELYNE.

London, W.14, December 30, 1947.

THE CORNISH ENGINES PRESERVATION SOCIETY

SIR,—On December 5, 1945, I drew the attention of your readers to the twilight of the Cornish Pumping Engine and suggested that the time was appropriate for those who were interested to send subscriptions to the Joint Secretaries of the Society at Falmouth. During the two years which have elapsed since you published my letter economic conditions in this country have deteriorated sadly but it is now all the more gratifying to be able to report that one of the few remaining engines has been secured for the Society. This is due to the generosity of Mr. Greville Bathe, of Philadelphia, U.S.A., who has provided the whole of the purchase cost. On November 29th the Deeds of Conveyance of the 90in engine, known as Taylor's Engine, were handed to the President of the Society, The Right Honourable The Viscount Falmouth, at a Meeting of the Society at the East Pool Mine.

An Endowment Fund for the maintenance of this magnificent machine has been started, and this was initiated by a very generous subscription from F. J. Pascoe, Esq., of British Timken, Ltd.

Taylor's engine was designed by the late Mr. Nicholas Trestrail, A.M.I.C.E., M.I.M.M., and was built by Harvey and Co., of Hayle, in 1892, for the Highburrow East Shaft of the Carn Brea Mine. It was re-erected at Taylor's Shaft, East Pool and Agar Mine, in 1924.

Taylor's engine is of exceptionally heavy construction and weighs alone 125 tons. The cylinder is 90in in diameter, with a 10ft stroke and the beam weighs about 52 tons. The maximum i.h.p. is 425. When first erected it gave a duty of 56,500,000ft lb per cwt. of coal and a consumption of 3·9 lb of coal per h.p. hour. Amongst other interesting data may be included the following: weight of boilers and fittings, 65 tons; the strapping plates and glands, 39 tons; iron pump rods, 89 tons; the plunger pumps and pump chambers 272 tons; the balance bobs, 45 tons; the grand total amounting to 684 tons.

In place of the normal wooden pump rods, 8in iron rods were used at Carn Brea for the first 113 fathoms of vertical shaft, but in the underlie (inclined) shaft wooden rods 15in square were used. When re-erected at East Pool square wooden rods were used throughout, tapering from 20in square at surface to 16in square at the bottom lift, the maximum depth being 1700ft. There are seven lifts, the diameters of the plunger poles being 18in down to the 1600ft level, with a 16in pole at the bottom level. The delivery is about 465 gallons per minute, at five strokes per minute, or 93 gallons per stroke. The total water load of this engine is approximately 85 tons. This is the heaviest weight of water set in motion per stroke by any pumping engine now working in Cornwall.

JOHN FOX.

London, E.C.2, December 17, 1947.

COLLEGE OF AERONAUTICS

SIR,—I wish to convey the thanks of the Principal and myself to you and your correspondent for the excellent article regarding the College, which appeared in your issue of 12th inst.

We would, however, like to point out an error. In the last paragraph of your article you state that the Principal "is assisted by a teaching staff of about 120." In actual fact, the number of teaching staff, including demonstrators, is twenty-four, and is not likely to rise much beyond this figure. Since you state, quite correctly, earlier in the article, that the student population is about 100, the figure of 120 teaching staff is liable to give rise to some comment. No doubt the mistake arose by a slight misunderstanding on the part of your correspondent, in that he probably took into account the larger proportion of ancillary administrative and industrial employees which are necessary to maintain a College of this nature and area.

V. F. KNIGHT,

Cranfield, December 22nd. Registrar.

BRAKING TRAM WHEELS

SIR,—In your December 12th issue you carried an interesting article (page 558) on "Improved Electric Traction Equipment." May I draw attention to an error in your description of the "inadvisability" of using rubber brake shoes on the tyres of resilient tram wheels?

Your article states that "it is not advisable to apply brake shoes to the tyres of resilient wheels, since the heat generated would in time cause partial vulcanisation of the rubber sandwich and destroy its characteristics."

This is, of course, quite erroneous—the rubber used is already vulcanised and any heat generated would, if sufficient, tend to soften and abrade the rubber. In this respect it is interesting to note that many proprietary brands of brake shoes contain a good percentage of rubber and give every satisfaction when used on tramcars.

J. P. LAWRIE.

London, E.C.3, December 29, 1947.

Prime Movers in 1947

No. I

DURING the year just ended good progress, if somewhat slower than in the previous year, was made in the design and testing of gas turbines, while new types of internal combustion engines were built and an external combustion engine, the Philips air engine, was produced in a commercial size. In these articles we shall record the progress made in these differing but related branches of engineering construction.

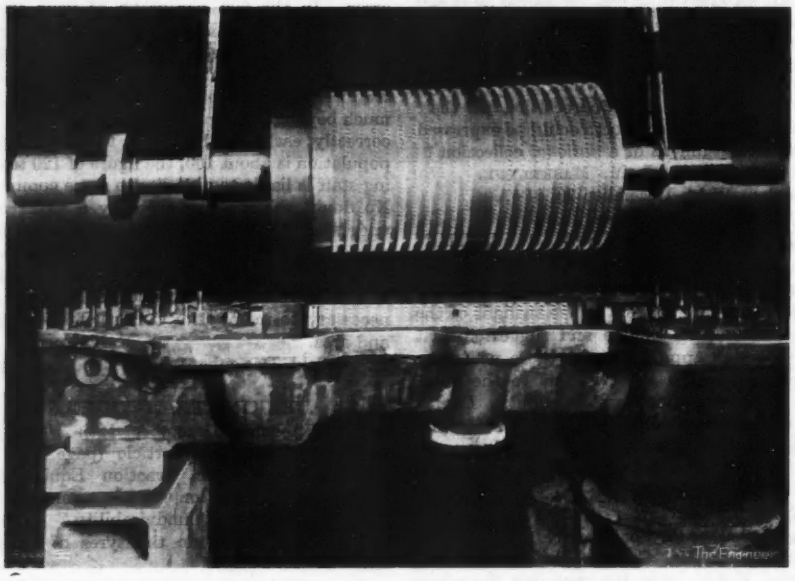
C. A. Parsons and Co., Ltd.

Last year we gave some illustrations of the 500 h.p. experimental gas turbine, working on a simple regenerative cycle, and burning "Pool" fuel oil, which was designed and built by C. A. Parsons and Co., Ltd., and was installed at the firm's Heaton Works. In the past twelve months this turbine was in continuous operation, and problems relating to the use of oil fuels with a high ash content were extensively studied. Some investigations were also carried out on the design, construction and testing of heat exchangers of the regenerative type.

Designs were prepared for two open-cycle gas turbine units, having designed outputs of 10,000kW and 15,000kW respectively, the maximum operating temperature being 1200 deg. Fah. The company also prepared designs of gas turbine plants suited for blast-furnace blowing.

John Brown and Co., Ltd.

At the Clydebank works of John Brown and Co., Ltd., work was continued on the manufacture of a 500 h.p. open-type gas turbine of Pametrada design. The main parts of that turbine were either all completed or were nearing completion by the end of last year and assembly in one of the shops will shortly begin. We show in the accompanying illustration the axial air compressor used with this plant. Our engraving shows the compressor rotor being lowered into its casing. Along side is a part view of the main regenerator, with the end cover removed, so that the tube-plate can be clearly seen.



500 B.H.P. Gas Turbine Compressor

For the first series of experiments, this 500 b.h.p. unit is to be run as an open-type turbine, for the purpose of testing blade materials and construction under actual working conditions. During these tests particular attention will be paid to the kind of deposits which collect on the blades, after running some time on crude and distilled fuels. Any signs of falling off in the efficiency of the compressor, or of the regenerator, caused by the fouling of surfaces, will be carefully investigated and measured. When sufficient data have been obtained, the combustion chamber will be replaced by an air heater and the cycle closed up. By this means it is hoped to obtain first-hand information which will enable the falling-off of efficiency in open-cycle and closed-cycle gas turbines to be compared.

Towards the end of 1947 John Brown and Co., Ltd., started to build a 12,500-kW closed-cycle gas turbine for power generation purposes. This new plant is being built under licence from the Escher Wyss Engineering Works, Ltd., of Zurich. It will operate on the Ackaret-Keller closed-air cycle and will in many respects be similar to the plant which Escher Wyss has under construction for the Gennevilliers Power Station near Paris, which was ordered last year. The general lay-out of this 12,500-kW plant in a power station is illustrated on the opposite page.

The expected efficiency of the plant at full load will be of the order of 32 per cent, with a maximum temperature at the high pressure turbine inlet of 1230 deg. Fah., and a cooling water temperature of 60 deg. Fah. The figure of 32 per cent efficiency is based on the output at the terminals of the generator and a gross calorific value of boiler fuel of 18,500 B.Th.U.s per lb.

The English Electric Company, Ltd.

In the period under review, we are informed by the English Electric Company, Ltd., that it made good progress with its research and development programme on various sizes and types of gas turbines for land, marine and railway traction purposes. In this work it had the benefit of a very close liaison with its associated company, D. Napier and Son, Ltd., whose equivalent activities in connection with aircraft propulsion are well known. Since many aspects of aerodynamics, combustion and manufacture and the like are common to the whole field of gas turbine application, the English Electric Company has found that the interchange of ideas and facilities has enabled it to bring a most useful breadth of experience to bear on its gas turbine problems. The actual work went forward steadily throughout 1947. Some running took place of prototype turbine parts and more than one prototype gas turbine plant was at the end of the year under construction. None of these plants had, however, reached the operating stage and results are not yet available for publication.

Regenerator for 500 B.H.P. Gas Turbine

Brown Boveri and Co., Ltd., Baden, (Switzerland)

In the course of 1947 two 10,000-kW gas turbine generator sets were despatched from the Baden works of Brown Boveri and Co. after successful trials. The first of these sets was that for the Filaret Power Station in Rumania, and the second set, which we illustrate in to-day's Special Supplement, was for South America. The latter was ordered by the Lima Light Power and Tramways Company, of Peru, for its Santa Rosa power station, where it is now being erected. It will be employed for standby load duties and it is expected to run 4000 to 5000 hours during the year. For this duty a high efficiency for partial load was necessary. A double-stage process was chosen with, for the first time, a two-shaft arrangement. As will be clearly seen from the accompanying diagram, there are two groups of machines one high pressure and the other low pressure, with the generator on the high pressure turbine shaft from which it is driven through reduction gearing. At the end of each of the shafts a starting motor is provided. The outside air is first taken through two low pressure compressors of the axial type, which are driven by the low pressure turbine. Between these compressors is the first stage intercooler and after leaving the second compressor the air passes through the second-stage intercooler, and to the high pressure compressor, which raises it to the

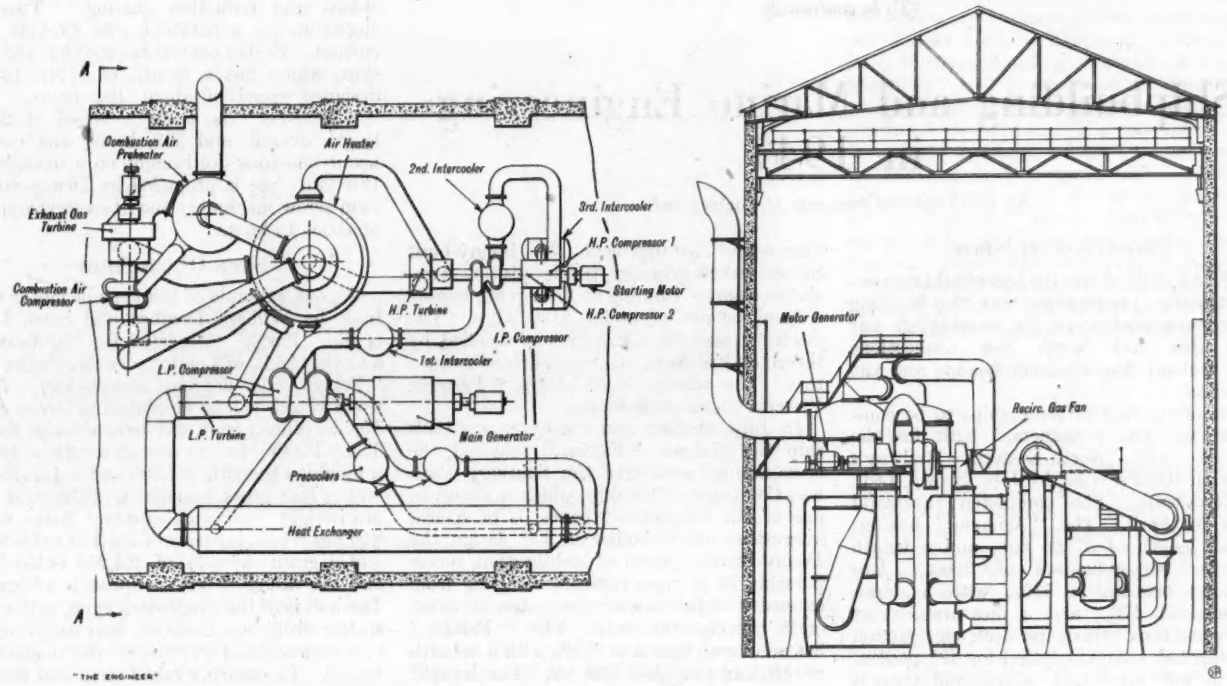
full working pressure. The compressed air leaving the high pressure compressor is further warmed in the preheater by the hot exhaust gases and passes to the high pressure combustion chamber, where it meets the oil fuel and is raised in temperature to a maximum limited only by the strength of the special steels used. Work is performed by the gas expanding through the high pressure turbine and after again receiving heat in the low pressure combustion chamber it is again expanded in the low pressure turbine and after giving up its heat in the regenerator to the air from the high pressure compressor, it escapes to the atmosphere. The works tests were carried out on a special steel foundation about 6m deep, which was constructed by Zschokke and Cie. This foundation, while light in construction, had a low natural frequency and during the trials we learn that throughout the load range of the set no vibration was recorded.

Some of the principal data are as follows: output of low pressure turbine about 12,000 kW; and output of the high pressure turbine about 20,000kW. The generator has a frequency of 60 cycles, and is designed to generate 10,000-V, 3-phase current, with an output of 12,500kVA. The high pressure turbine runs at 4750 r.p.m. and the generator at 3600 r.p.m., while the low pressure turbine group runs at about 3000 r.p.m.

The main temperatures are as follows: air at suction 30 deg. Cent. at sea level, gas condition of h.p. turbine 600 deg. Cent. and 8 atmospheres pressure, gas condition at low pressure turbine 560 deg. Cent. The temperature of the air before the preheater is about 100 deg. Cent. and after 350 deg. Cent., the gas temperature after leaving the preheater being about 190 deg. Cent. About 500 cubic metres of cooling water per hour is required, which enters the set at a temperature of approximately 25 deg. Cent.

The view on the test bed at Baden, reproduced in one of to-day's Supplements, shows the high pressure group of machines in the foreground and the low pressure group to the right. The two combustion chambers are vertical and behind them at end of the test bed will be seen the five air heaters. As will be seen from the engraving, the various units were partially or completely protected by heat insulation.

The set we have described is basically similar to that ordered by the North-East Power Company, of Switzerland, for Beznau. There are two units ordered for this station, one 13,000kW and the other 27,000kW. The erection of the 13,000-kW set was practically completed at the end of December, having taken place in the power station.

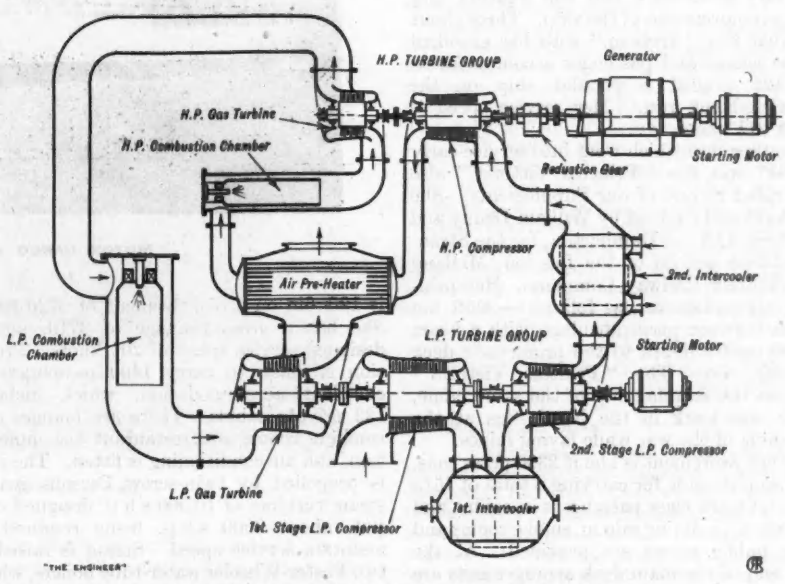


GENERAL ARRANGEMENT OF 12,500-KW CLOSED CYCLE GAS TURBINE GENERATOR PLANT

Railway Company from the British Brown Boveri, Ltd., of London, last year.

WERKSPOOR, AMSTERDAM

On several occasions since the liberation of Holland we have visited the Amsterdam works of N. V. Werkspoor, and have seen under construction and running the new marine oil engine, named the Werkspoor-Lugt engine, after its inventor, Mr. G. J. Lugt being the chief engineer of the diesel engine department of Werkspoor. It has



10,000-KW GENERATOR SET FOR SOUTH AMERICA

The running-up of the set is now dependent upon the completion of the switchgear and the connections to the overhead supply system of the supply company. Several other gas turbines for Spain, Venezuela, Egypt and Iran are going through the works, and work is also proceeding on the 2500 h.p. gas turbine ordered by the Great Western

two cylinders and is designed to develop normally 600 b.h.p. per cylinder or 1200 b.h.p. total, when running under normal supercharged conditions. The view we reproduce in to-day's Supplement shows the engine in an early stage of development, with two-stage scavenge pumps developing 950 b.h.p. One of these scavenge pumps was

dispensed with in later experiments and an exhaust gas turbine-driven blower used, under which conditions the engine fully develops its designed power. Before the end of the year successful experiments were carried out on the utilisation of the "Ordoil" grade of boiler fuel, which was employed in the Anglo-Saxon oil tanker "Auricula," and the engine is now running extended trials on this fuel. In a later article we propose to deal fully with this interesting marine oil engine.

(To be continued)

Shipbuilding and Marine Engineering in 1947

No. II—(*Continued from page 13, January 2nd*)

Cross-Channel Ships

A FEATURE of the 1947 shipbuilding construction programme, was the building of cross-channel ships to re-establish our Irish Sea and North Sea connections with Ireland, the Channel Islands and the Continent.

One of the first of these ships to be completed was the "Arnhem," built for the London and North-Eastern Railway's Harwich-Hook service, by John Brown, Ltd., of Clydebank. She completed successful trials in April. The "Arnhem" has an overall length of 377ft. 6in., and a length between perpendiculars of 350ft. Her moulded breadth is 52ft., with a depth moulded of 27ft., and a measurement of 4891 gross tons. Of shelter deck construction the ship has accommodation for 422 passengers in well appointed cabins, and there is good space for cargo and for motor vehicles. The Brown-built propelling machinery consists of geared steam turbines taking steam from two three-drum Yarrow type oil-fired boilers, with a working pressure of 300 lb and a final superheated steam temperature of 600 deg. Fah. In a separate auxiliary engine-room there are three Allen 210-kW oil engine-driven generators, which supply 220-V current for the deck and engine-room auxiliary machinery and the lighting and power requirements of the ship. Throughout the year the "Arnhem," with her excellent public rooms and passenger accommodation for 422 proved a popular ship on the Harwich–Hook run. Her service speed is about 21½ knots.

Another ship which went into service early in 1947 was the "Princess Victoria," also illustrated in one of our Supplements. She was built and engined by William Denny and Brothers, Ltd., of Dumbarton, for the Stranraer–Larne service of the London, Midland and Scottish Railway Company. Her principal dimensions are as follows:—305ft 6in length between perpendiculars, with a beam of 48ft and a depth to the promenade deck of 28ft. 6in. The "Princess Victoria" replaces the original ship of the same name, which was sunk in the North Sea at the beginning of the war while laying mines.

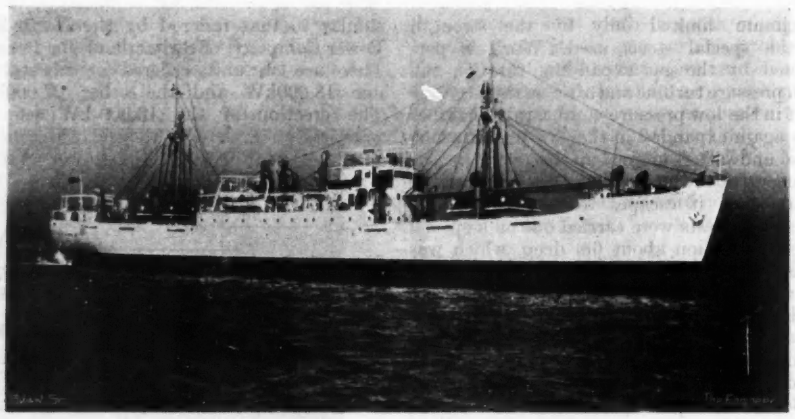
Her measurement is about 2300 gross tons. Provision is made for carrying a total of 1515 first and third class passengers in cabins and staterooms, a dining saloon, smoke rooms and other public rooms are provided. At the after end of the main deck arrangements are made for carrying about fifty motor vehicles, and a hand-operated turntable is fitted to facilitate on and off loading. The cars can be run off the ship under their own power through a large full-length opening arranged centrally at the stern of the ship and fitted with half-height hinged doors. Provision is made for carrying cattle and horses on the lower deck aft. The propelling machinery, which is designed for a speed of 19 knots, is a twin-screw arrangement of Denny-built Sulzer seven-cylinder trunk piston, two-stroke engines, running at 275 r.p.m., having a total output of about 5100 s.h.p. The electric power for auxiliaries is supplied by three 150-kW Allen oil engine-driven generators. The service speed of the "Princess Victoria" is about 19 knots.

In July, another noteworthy Denny-built ship the steamer "Falaise," entered the cross-channel service of the Southern Railway Company. This ship, which is shown in one of our Supplement pages, is of special interest as she embodies in her design the Denny-Brown system of stabilisation, incorporating in it improvements resulting from extensive experience of the system in naval craft during the war. The "Falaise" has an overall length of 314ft, with a breadth of 48ft, and a depth of 17ft 6in. The draught is 12ft 6in on a displacement of 2720 tons. She has a gross tonnage of 3710, and a designed service speed of 20½ knots. Provision is made to carry 1400 passengers in excellent accommodation, which includes 133 private cabins. There are lounges and smoking rooms and restaurant accommodation, and air conditioning is fitted. The ship is propelled by twin-screw Parsons geared steam turbines of 10,000 s.h.p. designed output, about 9000 s.h.p. being required to maintain service speed. Steam is raised in two Foster-Wheeler water-tube boilers, which are oil fired, and are designed for a working pressure of 450 lb and a final steam temperature at the superheater of 750 deg. Fah.

At sea, the power for lighting and for auxiliary machinery is furnished by two Allen 200-kW turbo-generator sets, and there is an Allen oil-engine-driven generator of the same output which is for use in port. Other Southern Railway ships which were built by William Denny and Brothers, Ltd., for the Southern Railway service included the "Farringford," for the ferry service between Lymington and Yarmouth, in the Isle of Wight, and the "Winchester," for cargo and cattle traffic. The "Farringford" is a double-ended ship propelled by paddle wheels which are electrically driven through chains and reduction gearing. Two oil engine-driven generating sets provide the current. Bridge control is provided and the ship, which has a length of 178ft, has a designed speed of about 10½ knots. The "Winchester" is a cargo vessel of 230ft length overall, and 36ft beam, and carries about 650 tons deadweight on a draught of 12ft 9in. She is propelled by Denny-Sulzer twin-screw machinery and has a service speed of about 15 knots.

Some Other Ships

A good example of the type of motor ship built by William Doxford and Sons, Ltd., is the "Pinto," completed for MacAndrews and Co., Ltd., of London. A sister ship, the "Pelayo," is nearing completion. Both these vessels will be employed in the owner's Mediterranean fruit and general cargo trade. The "Pinto" has an overall length of 350ft, a moulded breadth of 50ft, and a draught of 90ft. Her gross tonnage is 2470, and her deadweight carrying capacity 3400 tons. She has a bale capacity of 205,120 cubic feet, and a grain capacity of 224,240 cubic feet, and her designed service speed is 16 knots. The hull is of the single-deck type, with open shelter deck, and there are four cargo holds, two forward and two aft of the machinery spaces. The sharply raked stem and cruiser stern of the ship may be noted. The officers are comfortably accommodated in the 'midship deck-house and on the boat deck, and the crew in 'tween decks aft. A Thermotank cold air system is installed for the fruit-carrying chambers.

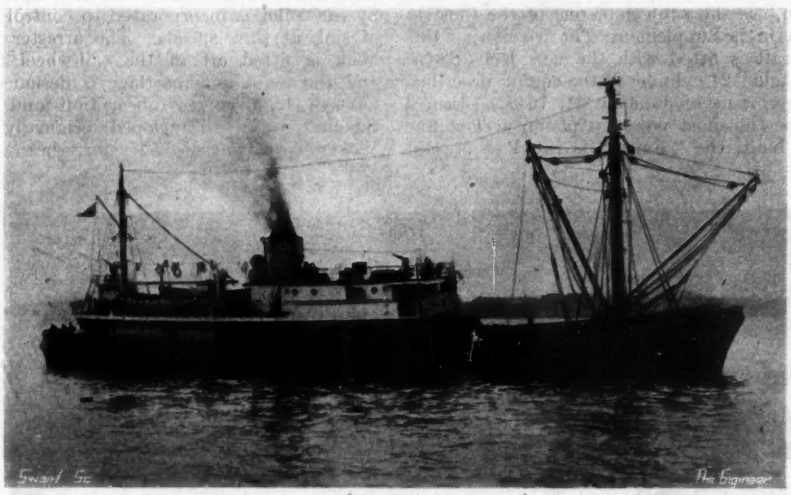


MOTOR CARGO AND FRUIT SHIP "PINTO"

The engine is a five-cylinder Doxford opposed-piston unit, with a crank-driven scavenge pump, and it is designed to develop 4000 s.h.p. at 120 r.p.m. Current is supplied by two Allen 150-kW oil engine-driven generator sets.

Shortly before the end of the year, the official trials took place of an interesting ship designed and built by John I. Thornycroft and Co., Ltd., for the Khedival Mail Line Fleet, the "El Malek Foad." She is to be employed on mail and passenger service between Alexandria and Marseilles. Her length is 357ft 9in and her breadth moulded 50ft, with a depth moulded of 28ft. There are three cargo holds, one aft and two forward of the machinery space, and also 'tween

deck spaces, in which special arrangements are made for the carriage of motor cars. There is passenger accommodation for some 250 first and second-class passengers, and air conditioning is fitted to the public rooms. The furnishings, both in the cabins and the public rooms, are comparable with modern liner practice, while the latest safety cargo handling and navigation equipment is installed.

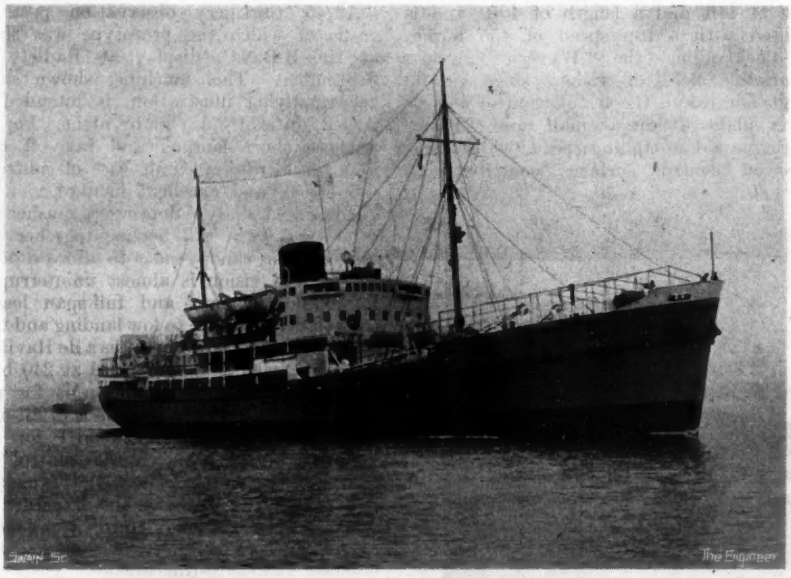


MERSEY SALVAGE STEAMER "SALVOR"

The propelling machinery is designed for a service speed of over 20 knots, and it comprises a twin-screw set of Parsons geared turbines, which have a maximum output of about 8000 s.h.p. at 250 r.p.m. Steam is raised in single-sided three-drum Thornycroft boilers, which are of the latest design with air heaters and superheaters. Most of the auxiliaries are of the Weir and Drysdale steam reciprocating and rotary types, and electric current is supplied by one Allen 125kW turbo-generator and two Mirrlees-Maudsley oil-engine-driven generator sets.

An interesting vessel recently delivered from her builders, Ferguson Brothers (Port Glasgow), Ltd., to the Mersey Docks and Harbour Board, was the twin-screw salvage steamer, "Salvor," which is claimed to be one of the most complete salvage ships yet constructed. A view of the ship is reproduced herewith. She has a length of 164ft 6in, a beam of 34ft 2in, and a depth of 15ft 1in. In addition to being fully equipped with every salvage device, the "Salvor" is also designed to deal with dock and ship fires, and to lay heavy moorings and buoys. She will also be used for survey work in the River Mersey and Liverpool Bay.

The twin fire and salvage pumps are of Drysdale make, and they are housed on the main deck, with suctions each side for salvage purposes and sea suctions for fire purposes. The two large fire-fighting monitors are situated on the upper deck, and in addition there are six portable fire guns on each side of the main deck bulwarks. A considerable number of fire hose connections are also ranged around each top deck monitor. The equipment also includes arrangements for fighting oil fires, and the ship herself is protected from spread of fire inboard by drenching and spraying nozzles. The deck equipment, which will be seen in our illustration, includes heavy lifting derricks for buoying operations, and there are two Clarke Chapman heavy electrically operated capstans, and a special steam winch forward. The bow of the ship is designed with a substantial rubbing piece, which will take a 100-ton lift.



KHEDIVAL MAIL LINER "EL MALEK FOAD"

The main propelling machinery contains the twin-screw triple-expansion steam engines which were built by Ferguson Brothers and have a designed output of about 1450 s.h.p. Steam is raised in two marine type return-tube boilers, which are fitted with Howden-Wallsend oil burners. The navigation aids include a modern bridge pattern radar installation, with a revolving scanner on the mast truck, and its motor generator in the forehold. Other navigational aids include echo sounding, searchlights, and a Marconi type radio-telephone installation. The "Salvor" has spacious accommodation not only for her ship's officers and crew, but also for surveying staff and a wreck-raising party.

(To be continued)

Canadian Engineering Notes

Hydro-Electric Progress in British Columbia

In the two years since the formation of the British Columbia Power Commission rapid strides have been made in the Commission's hydro-electric power development scheme at Campbell River. This project has been planned for development, stage by stage, with construction to proceed in accordance with expected power requirements. The initial stage includes, for its first phase, the construction of head dams and the intake at Irene Pool, together with the construction of a surge tank and a closed conduit of sufficient size to operate two turbo-generator units of 25,000 h.p. each. Also provided for in the first phase are the construction of the first power-house bay of sufficient size to house one 25,000 h.p. unit and the complete installation of this unit. The second part of the first stage provides for the completion of the second 25,000 h.p. unit. Construction of a dam at Ladore Falls to raise the level of the waters at Campbell Lake forms the third and last phase of the project in its first stage of development.

The particular work on which the Commission is at present engaged includes construction of the reinforced concrete dam at Ladore Falls referred to above, which will raise the level of Lower Campbell Lake by about 58ft; the main dam at Irene Pool, of the concrete gravity type with wing walls of sealed earth embankments, this dam being 650ft long at the crest with a base thickness varying from 100ft to 55ft at the ends of the structure; intake and penstocks of reinforced concrete at a point 15,000ft south of the southern end of the dam; a differential surge tank near the power-house to provide for pressure changes in the pipe line and penstock; a power-house with a concrete substructure, which will be equipped with an overhead crane; about 250 transmission towers, spaced approximately six per mile; and two sub-stations, one each at Alberni and Nanaimo.

Engines for India

Negotiations have been completed between officials of the Canadian Locomotive Company, Kingston, Ontario, the Montreal Locomotive Works and officials of the Government of India, resulting in a contract for 150 engines. Of these, the Montreal firm received an order for ninety and the Kingston plant one for sixty engines. Both companies have substantial orders on hand for the Canadian railways. Deliveries of the India order are expected to start in August of 1948, but both plants will be engaged in production until well into 1949. The India order was taken in competition with all the United States locomotive companies. At a time when American dollars are providing a critical problem for Canada, it is interesting and important to note that payment will be made in United States funds.

Aeronautics in 1947

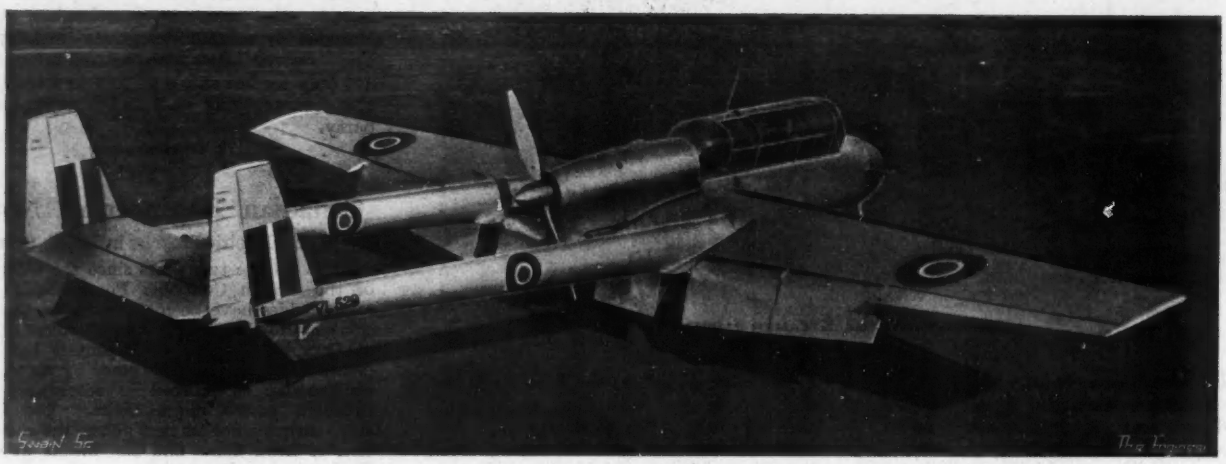
No. II—(*Continued from page 23, January 2nd*)

Military and Naval Aircraft

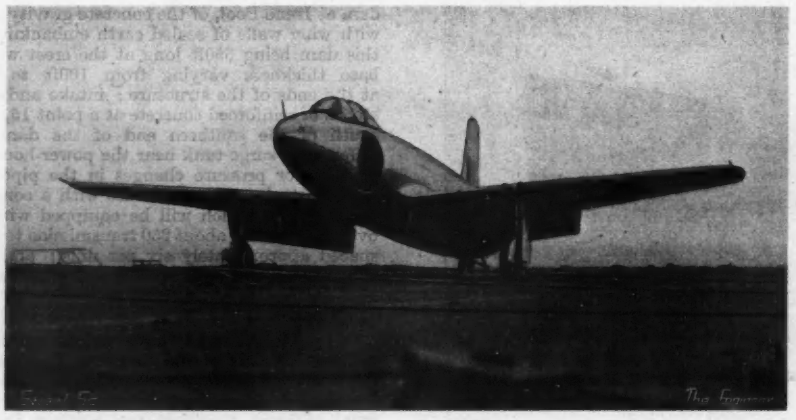
FEW completely new types of service aircraft appeared during the year. Certainly one of the more interesting was the "SR/A1" twin-jet flying-boat fighter, built by Saunders-Roe, Ltd., which was demonstrated last July. In one of the views in the Art Supplement this machine is shown in flight. A full description appeared in our issue of August 8, 1947, but the main points of the design, we may recall, are that propulsion is by two Metropolitan-Vickers "F2/4" "Beryl" jet turbines, enclosed within the hull, with a common air intake at the extreme bows and jet outlets aft of the wing, on each side of the hull. The span of the machine is 46ft and beam of the hull 6·83ft. The "Beryl" jet units are but 37·9in overall diameter and therefore fit neatly side-by-side, yet are rated for 3500 lb static thrust at ground level for take-off. In designing this machine the aim has been to give a very high performance, and to take advantage of the ram effect produced by high speeds combined with efficient air intakes. The wing floats are retractable in flight and the pilot is seated within a pressurised cabin. The armament comprises four 20mm cannon in the hull nose.

Another new naval single-seat fighter, striker and intruder, the Westland "Wyvern," is the subject of one of the illustrations in the Supplement. The first mark of this aircraft is fitted with the new Rolls-Royce "Eagle" 24-cylinder piston engine, described in our issue of January 31, 1947. Claimed to be the most powerful piston aero-engine yet built, the "Eagle" is rated at present at 3500 b.h.p., and gives the "Wyvern" a notable performance. The aircraft has a normal gross weight of 22,000 lb; it has a span of 44ft and a length of 40ft, and is credited with a top speed of 455 m.p.h. For decklandings the "Wyvern" gives a remarkable field of vision, since careful design has led to the installation of a large power plant within a small nose. Power flaps give a low landing speed, whilst large balanced control surfaces contribute to effective control during the approach. To comply with decklanding requirements, the undercarriage, which is liquid sprung, is of particularly robust design.

Yet another naval aircraft of the year was given flying trials, when, in October, 1947, the naval version of the Vickers Supermarine "Attacker" jet fighter made deck landings on board H.M.S. "Illustrious." This was the first occasion on which a jet-propelled aircraft with tail-wheel landing gear had been landed on a ship, and the successful results demonstrated that a tricycle undercarriage is not essential for deck landings. In the naval version of the "Attacker," which, of course, is equipped with a Rolls-Royce "Nene" jet engine, lift control in the form of spoilers operated by the pilot is incorporated to control rate of sink at slow speeds. The arrester wire hook is fitted aft of the tail-wheel unit, and the main undercarriage is designed to have a high energy absorption and low rebound ratio. Developed originally by Vickers-Armstrongs, Ltd., for the "Seafang," this type of undercarriage leg has a long stroke.



HESTON A2/45 ARTILLERY OBSERVATION POST AIRCRAFT



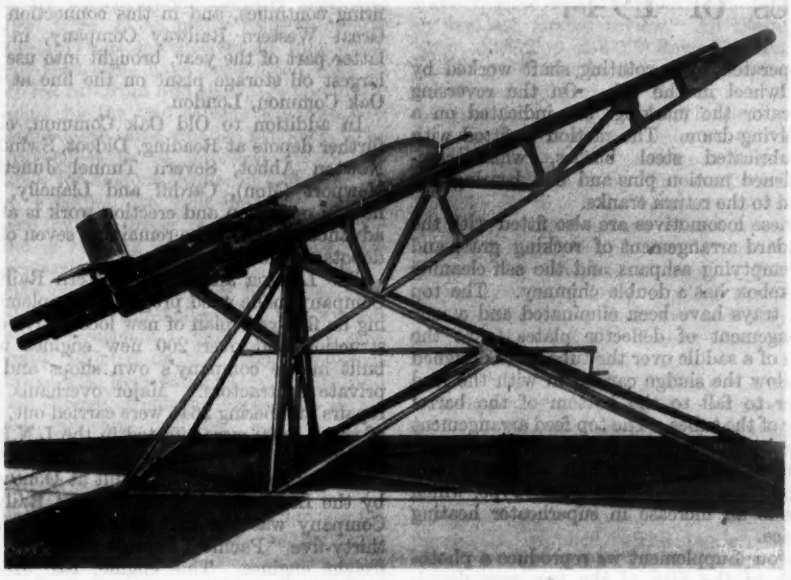
VICKERS SUPERMARINE NAVAL "ATTACKER" JET FIGHTER

Much interest attaches to the Heston "A2/45" artillery observation post aircraft, of which the prototype was shown at the S.B.A.C. display at Radlett last September. This machine, shown in an accompanying illustration, is intended for A.O.P. duties by day or by night. For this purpose short landing and take-off runs, high initial rate of climb, ease of control at low speed, and excellent field of view are all required. By adopting a pusher airscrew and twin tail booms, together with bulged cabin canopy sides to afford a downward view, vision is almost uninterrupted. Large slotted flaps and full-span leading edge slats contribute to low landing and take-off speeds. The power plant is a de Havilland "Gipsy Queen 33" unit rated at 240 b.h.p. at sea level. Accommodation is for pilot and observer. The aeroplane is of all-metal construction, "Alclad" covered for durability, excepting the fabric control surfaces. To permit transport of the machine in small trucks by road, the structure can be dismantled quickly into components, all of which, excepting the engine, can be handled without lifting tackle.

Pusher engine layout in this machine presented some difficulty in cooling arrangements. It was ingeniously overcome by incorporating below the cowling a large air-intake, with ducts for cylinder cooling, oil cooling, carburettor air and cabin ventilation. The air is exhausted through an annular opening round the airscrew hub. An extractor fan in the hub induces a flow through the cooling system during ground running and supplements the normal flow at low flying speeds.

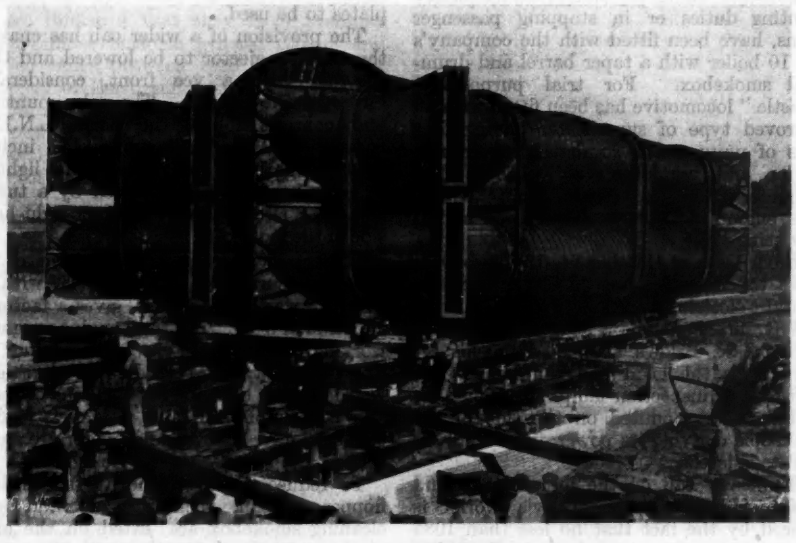
Military version of the "Viking," the Vickers "Valetta," illustrated in one of the Supplement pages, was demonstrated at Radlett last September. This machine is

AERONAUTICAL RESEARCH IN 1947



FAIREY GUIDED MISSILE

GUIDED MISSILE IN FLIGHT



STRATOSPHERE CHAMBER UNDER CONSTRUCTION

to be the standard R.A.F. medium military transport, and will replace the famous "Dakota." In the "Valetta," as compared with the "Viking," there are more powerful engines, and there is a large main door, 8ft 6in by 5ft 8in, the floor is heavily reinforced and the cockpit is larger, for there is room for a navigator in addition to two pilots and a radio operator. As a troop transport thirty-six fully-armed men are carried with their equipment. When modified for parachuting airborne troops, the aircraft carries twenty equipped men and nine containers of weapons and supplies, the latter stowed beneath the fuselage. A large glider can be towed, whilst as a freighter, jeeps, 25-pounder guns, a three-ton lorry, or more than four tons of miscellaneous freight can be carried. The twin engines are Bristol "Hercules 230" units, each rated at 2000 b.h.p.

GUIDED AND ROCKET MISSILES

In October, 1947, we began the publication of a series of articles by Mr. Eric Burgess, which reviewed the many types of German guided and rocket missile developed during the war. Although we are usually not permitted to refer to work of this type which is of more recent date, it is interesting to note that particulars were given, in April, 1947, of the Fairey guided missile, said to be the first British pilotless radio-controlled rocket missile. Under development for eighteen months the new missile reached a stage where a controller on the ground could exercise full flight control. Accompanying illustrations show the missile—coded name "Stooge"—on its launching ramp and in flight. With four 75 lb thrust rockets the maximum speed was said to be more than 500 m.p.h. A description of the Fairey guided missile was given in THE ENGINEER for April 18, 1947, to which the reader is referred for full details of this interesting development.

RESEARCH AND DEVELOPMENT EQUIPMENT

Very large sums of money were expended during the year by firms and by the Government in building up and improving research plant. As an example, Vickers-Armstrongs, Ltd., had under construction at Weybridge, a stratospheric test chamber, capable of housing a full-sized fuselage. A description of this structure was given in our issue of September 26, 1947, and we reproduce a photograph taken recently, when the chamber was being moved on to brick foundations, built at the same time as the structure of the chamber itself was erected. Plant is to be installed capable of reproducing in the chamber, 25ft diameter and 50ft long, conditions of temperature and pressure such as may be experienced in any latitude and up to an altitude of 70,000ft. We learn that at the end of the year the chamber was nearing completion. In addition two new wind tunnels were being built at Weybridge.

HOT TEARS IN STEEL CASTINGS.—The steel division research committee of the American Foundrymen's Association is to sponsor a study of the influence of mould conditions on the development of hot tears in steel castings. The research will be confined to an investigation of factors within the mould itself, and is expected to determine which factors contribute to the development of the defect and to what extent, and to indicate suitable methods for the control of hot tearing in production operations. The design of a pattern to serve as a measure of the tear susceptibility of various steels is also to be included in the study.

Some Locomotives of 1947

DURING the past year no new types of steam locomotives of particular note were built or placed in service by any of the main line railway companies in this country. A certain number of interesting modifications were made to some of the better-known types of locomotives, but the large amount of heavy repair and overhaul work still outstanding as a result of the war, coupled with shortages of materials, combined to make major development work out of the question. The unsatisfactory locomotive position was made plain in a White Paper on "Capital Investment in 1948," where it was shown that 8000 engines, or 39 per cent of the total in this country, are over age. There were about 3750 locomotives under or awaiting repair at any one time, and operating was difficult owing to the increasing number of breakdowns. It is proposed that nearly 600 new locomotives shall be built in 1948—about the normal number required for current annual renewals and contributing nothing to the accumulated replacement arrears of the war years.

The London, Midland and Scottish Railway Company built some 113 new engines in 1947 and carried out some 4600 classified repairs. The new locomotives included a new design Class "4," 2–6–0 freight tender engine, with two outside cylinders, a double blast pipe and chimney and other of the latest features incorporated into the company's practice.

A number of the Class "5," 4–6–0 mixed-traffic engines built by the company included nine with Walschaerts valve gear, one with Stephenson gear and two with Caprotti gear, all being fitted throughout with Timken roller bearing axle-boxes. Other engines being built in this class will have Caprotti gear and be fitted with plain bearings. It is proposed to try these groups of locomotives against one another and with standard Class "5" engines having plain bearings and Walschaerts valve gear.

In connection with the introduction of a new diesel-electric locomotive, the first unit of which was described in our issue of December 26, 1947, the company decided to build two new 4–6–2 steam locomotives to obtain comparative data on modern developments in motive power. The first of these two steam locomotives, No. 6256 and named "Sir William A. Stanier, F.R.S.," was completed.

While these two locomotives are to the same general design as the existing 4–6–2 "Coronation" type, as introduced by Sir William Stanier, Mr. H. G. Ivatt, the chief mechanical engineer, has introduced some additional features with the idea of obtaining increased availability, reducing maintenance costs and giving longer periods between workshop repairs. All axles of the engine and tender have been fitted with roller bearings.

The back end of the locomotive has been redesigned. The main plate frames terminate at a point behind the trailing coupled axle, where a semi-bar type frame, 2in thick, is riveted on and extended to the hind buffer beam. Support brackets on this frame rest on spherical bolsters sliding on the top of the pony truck, which is also of new design. This pony truck is a single steel casting embracing the pony truck wheels. Side check gear of the coil spring type is fitted.

In redesigned reversing gear the screw bracket itself is mounted on the main frame near the main reversing shaft and the screw is operated by a rotating shaft worked by handwheel in the cab. On the reversing indicator the markings are indicated on a revolving drum. The motion is fitted with oil-lubricated steel bushes, while case-hardened motion pins and ball bearings are fitted to the return cranks.

These locomotives are also fitted with the standard arrangement of rocking grate and self-emptying ashpans and the self-cleaning smokebox has a double chimney. The top feed trays have been eliminated and a new arrangement of deflector plates takes the form of a saddle over the tube bank designed to allow the sludge carried in with the feed water to fall to the bottom of the barrel clear of the tubes. The top feed arrangement whereby the water is deaerated is retained. Other fittings include blow-off cocks and superheater elements of "5P4" type, which provide an increase in superheater heating surface.

In our Supplement we reproduce a photograph of the first of the two new diesel-electric units, built by the L.M.S. in conjunction with the English Electric Company, Ltd. A second identical unit is now in course of construction. The principal particulars of each unit are as follows :—

Type	0–6–6–0
Diesel engine continuous rating...	1600 h.p.
No. of cylinders	Sixteen
Dimensions of cylinders	10in bore by 12in stroke
Maximum engine revolutions ...	750 r.p.m.
Tractive effort (maximum)... ...	41,400 lb
Tractive effort (continuous rating)	15,000 lb
Length over buffers	61ft 2in
Estimated weight in working order	121 tons 10 cwt
Engine fuel capacity, main tank...	815 gallons
Engine fuel capacity, service tank	85 gallons

Each unit has a driving cab at both ends so that it can operate as a separate locomotive; while, when coupled together, the two units form a complete locomotive of 3200 h.p., controllable from one end by a single crew.

When it has completed preliminary trials the first unit will go into fast regular passenger service, and later the two units will be coupled together for express passenger service on the Euston-Glasgow main line.

Of the new locomotives built by the G.W.R., ten were of the 4–6–0 two-cylinder "Hall" class and seven of the 4–6–0 "County" class. Of twenty 0–6–0 tank locomotives built, ten, intended for heavy shunting duties or in stopping passenger trains, have been fitted with the company's No. 10 boiler with a taper barrel and drum-head smokebox. For trial purposes a "Castle" locomotive has been fitted with an improved type of superheater having four rows of units and a combined superheater header and regulator valve body. The design for a similar superheater for a "King" class engine has also been prepared and is now being built.

In our issue of October 24, 1947, we were able to describe an interesting experimental electric lighting set which the G.W.R. fitted to the 4–6–0 oil-fired locomotive "St. Bride's Hall." With this set current for the head and tail lamps, cab lighting and inspection lamps is supplied by an alternator mounted on the side of the smokebox, deriving its power from a steam-operated ejector.

The heavy call on the maintenance and repair side of this company's works is evinced by the fact that no less than 1085 heavy repairs were carried out in the shops during 1947, in addition to a large number of light repairs.

The conversion of locomotives to oil fuel firing continues, and in this connection the Great Western Railway Company, in the latter part of the year, brought into use the largest oil storage plant on the line at Old Oak Common, London.

In addition to Old Oak Common, eight further depots at Reading, Didcot, Swindon, Newton Abbot, Severn Tunnel Junction, Newport (Mon), Cardiff and Llanelly, are now in operation and erection work is at an advanced stage at the remaining seven other depots on the system.

The London and North-Eastern Railway Company made good progress in implementing its five-year plan of new locomotive construction and over 200 new engines were built in the company's own shops and by private contractors. Major overhauls and repairs numbering 2645 were carried out, and of these, 2600 were effected in the L.N.E.R. shops.

Among the locomotives built at Doncaster by the London and North-Eastern Railway Company was the first of a new series of thirty-five "Pacific" express passenger and freight engines. This engine, No. 525, is illustrated in the Supplement, and it has been appropriately named the "A. H. Peppercorn," after its designer.

The new engine has been classified "A2" and differs considerably in detail and appearance from those of the previous order built during the *régime* of Mr. Edward Thompson, now designated "A2/3." The three cylinders, of 19in diameter by 26in stroke, have been brought closer together by moving forward the outside cylinders to the more orthodox position between the bogie wheels, thus shortening the exhaust ports and eliminating the external exhaust ducts. At the same time, the bogie has been brought back nearer to the coupled wheels, and the total wheel base shortened by 2ft 7in. As before, the drive is divided, the inside cylinder acting on the leading coupled axle and the outside cylinders on the middle axle. The inside connecting-rod and Walschaerts motion is identical with that used on the previous locomotives, while the outside gear has been lengthened and closely resembles that used on the "B.1" class of 4–6–0.

The boiler is unaltered in general dimensions and carries a pressure of 250 lb per square inch. The dome, however, has been replaced by a steam collector of the familiar L.N.E.R. pattern and the use of 3 per cent nickel alloy steel has enabled thinner barrel plates to be used.

The provision of a wider cab has enabled the vacuum ejector to be lowered and this, together with a vee front, considerably improves the lookout. The cab mountings and controls follow the usual L.N.E.R. practice for "Pacific" engines, but include electric lighting. Current for cab lighting and the headlamps is supplied by a turbo-generator situated on the front right-hand side of the footplate.

The tractive effort at 85 per cent of the boiler pressure is 40,430 lb, which, with an adhesive weight of 66 tons, gives a factor of adhesion of 3·67. The total engine weight in working order is 101 tons. The engines are fitted with standard tenders of the eight-wheeled type, carrying 5000 gallons of water and 9 tons of coal, and weighing, loaded, 60 tons 7 cwt. Engine and tender are steam braked and fitted with electric lighting.

To reduce disposal time at the sheds a hopper ashpan, rocking grate and self-cleaning smokebox are fitted on the locomotive, and these, together with the accesi-

bility of the motion and valves, should assist the shed staffs in routine examination.

Eighteen "West Country" locomotives, built by the Southern Railway Company in 1947 were in all major respects similar to the previous locomotives of that class, except that some have been fitted with an improved cab front and the space previously occupied by the two cabside windows now accommodates three smaller windows. The general effect is an improvement in the facilities for lookout, while, in addition, the front windows can now be reached and cleaned by the driver or fireman when the engine is running and window wipers are unnecessary.

Some of the new engines have also been fitted with the self-contained T.I.A. system of water treatment. This system is now generally adopted on the French National Railways with very satisfactory results, and similar success, from the experience so far gained, appears probable on the S.R. engines that have been fitted.

Private Locomotive Manufacturers

When we turn to the private locomotive building firms in this country we find that they are in a similar position to the main line railway companies. Their books are well filled with orders for engines of known and proved types for both home and abroad, and but little work of new or outstanding nature has been possible.

As a result of the particularly good performance of four "15th" class 4–6–4 + 4–6–4 Beyer-Garratt locomotives supplied by Beyer, Peacock and Co., Ltd., to the Rhodesian Railways in 1940, thirty similar engines were ordered. Ten of these engines were completed in 1947 and one of them is illustrated in the supplement. Although the service on which the original locomotives are used is fairly arduous, we are informed that they have averaged 250,000 miles between general repairs and 120,000 miles between tyre turning. The efficiency of the design is such that only a few minor alterations have been made in the new engines. One of these changes, as can be seen, is a slight alteration in the shape of the tank.

Designed for a maximum axle load of 13¼ tons, the engines weigh 179½ tons in full working order, and as a matter of interest we give the following list of their principal dimensions :—

Cylinders (4)	17½in by 26in
Valve gear	Walschaerts
Piston valves	9in dia.
Coupled wheels	4ft 9in dia.
Boiler pressure	180 lb per sq in
Evaporative heating surface :	
Tubes	2,124 sq ft
Firebox	212 sq ft
Total	2,336 sq ft
Superheater surface	494 sq ft
Grate area	49·5 sq ft
Coal capacity	10 tons
Water capacity	7,000 gallons
Tractive effort (at 75 per cent b.p.)	37,720 lb
Tractive effort (at 85 per cent b.p.)	42,750 lb

A further fifteen 4–8–2 + 2–8–4 Beyer-Garratt engines ordered by the South African Railways, have been completed. One of these engines was illustrated and described in our last annual review. An interesting little 2–6–2 + 2–6–2 Beyer-Garratt for 2ft 6in gauge was built early in the year for the Nepal Government Railways. It was designed to an axle load of 5 tons with a total weight in working order of 47·5 tons. At 85 per cent boiler pressure it has a tractive effort of 17,000 lb. For the Leopoldina Railway in Brazil the company completed four tank engines, for use on surburban lines at Rio de Janeiro, and five "Pacific" type engines. A number of these "Pacific" locomotives have been supplied previously to the Leopoldina Railway, and they are fitted with a special firebox designed to burn Brazilian national coal.

The North British Railway Company, Ltd., has built a number of locomotives for mining companies in South Africa, during the past year. Among these locomotives were five 4–8–2 and two 4–8–4 tank engines, and four 4–8–2 engines and tenders, all being of similar designs to locomotives previously supplied. The tender engines were similar to some heavy goods locomotives designed and built in the past for the South African Railways. They have a working pressure of 190 lb per square inch and a tractive effort, at 75 per cent boiler pressure, of 41,840 lb. In full working order each engine weighs 98 tons 14cwt.

One order in hand at the North British works, and due for completion in 1948, is for a hundred 3ft 6in gauge 4–8–2 engines and tenders for the South African Railways. A photograph of one of these engines, a hundred of which were completed in 1946, is reproduced in our supplement. Their leading dimensions are as follows :—

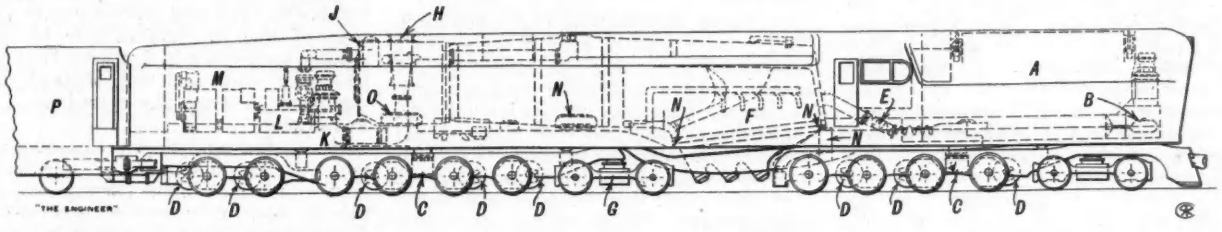
Cylinders (2)	24in by 28in
Coupled wheels	5ft dia.
Coupled wheelbase	15ft 9in
Total wheelbase	35ft 8in
Boiler pressure	210 lb per sq in
Heating surface, evaporative	3,415 sq ft
Heating surface, superheating	661 sq ft
Fire-grate area	62·5 sq ft
Tractive effort at 85 per cent b.p.	47,980 lb
Weight in working order	112 tons

During the year this company completed an order for one hundred 4–6–0 engines and tenders of the "B.1" type for the London and North Eastern Railway, and an order now in hand for 150 similar engines is to be completed in 1948.

We are informed by the Yorkshire Engine Company, Ltd., that the past year has been largely devoted to modernisation and reorganisation of the works, which have been replanned and re-equipped, to deal with the post-war demand for locomotives. Although this work has of necessity slowed production down somewhat several new industrial locomotives of the familiar types in which the company specialise have been completed.

In addition to filling a number of orders for industrial steam locomotives, Robert Stephenson and Hawthorns, Ltd., has nearly completed an order for six "B 1" locomotives and tenders for the 5ft 6in gauge Ceylon Government Railways. These 4–6–0 engines have a working pressure of 160 lb per square inch and at 85 per cent boiler pressure the tractive force is 22,620 lb per square inch. The company also completed an earlier order for fifty "19 D" class 4–8–2 locomotives for the South African Railways.

Particular interest attaches to three locomotives being built in the United States by the Baldwin Locomotive Works for the Chesapeake and Ohio Railway. We are able to reproduce in our supplement a photograph and give below a diagram of the first of these engines to be completed. It is claimed to be the first coal-burning steam turbine electric locomotive and the largest passenger locomotive in the world. The engine combines in one self-contained motive power unit a conventional steam boiler, a steam turbine, and electric drive. The leading unit of the locomotive is a bunker, capable of taking 29 tons of fuel, from which the coal is fed rearwards to the boiler furnace by means of a mechanical stoker. It will be noted that the conventional arrangement of the boiler, with the smokebox in the leading position, has been reversed and the firebox end is forward, adjoining the bunker unit. Interposed between the bunker and the boiler is a large, totally enclosed driver's cab.



A Coal Bunker
B Stoker Engine
C Centre Pins (2) Main Frames
D Traction Motors (8)
E Stoker Elevator
F Boiler
G Intermediate Truck
H Chimney
J Feedwater Heater
K Main Turbine
L Reduction Gearing
M Generators (2)
N Boiler Supports (Sliding 5)
O Boiler Support (Fixed)
P Tender

6000 H.P. Steam Turbine Electric Locomotive—Baldwin

The boiler, with a working pressure of 310 lb per square inch, has an evaporative heating surface of 4406 square feet and a grate area of 112 square feet. At the rear of the boiler is the main self-contained power unit, consisting of a 6000 h.p. impulse-type, non-condensing, Westinghouse steam turbine, driving a single helical reduction gear unit. This gear unit drives two shafts at 1000 r.p.m. and to each shaft is coupled a 2000-kW, 580-V Westinghouse main generator. Each of the two generators comprises two 1000-kW units having armatures mounted on a single shaft, with the commutators at opposite ends. Each of the four 1000-kW units supplies current for two traction motors permanently connected in parallel.

The locomotive is carried on two articulated units with a centrally disposed four-wheeled truck. The driving wheels are 40in diameter, the rigid wheelbase being 17ft 6in long and the total engine wheelbase 90ft 7in long. With a total weight of 823,000 lb in full working order the weight on the driving wheels is 508,000 lb.

A separate water tender carrying 25,000 gallons of water and weighing 371,800 lb, is blended into the general lines of the locomotive.

(To be continued)

Carbide Tipped Tools

THE INSTITUTION OF MECHANICAL ENGINEERS

AN extra general meeting was held at the Institution, London, on Friday, January 2, 1948, with Dr. D. R. Pye, C.B., Vice-President, in the chair.

The following paper (of which abstracts are reproduced on page 53) was presented and discussed :—"Modern Cutting Tools and Machine Tool Design," by C. Eatough, B.Sc. Tech., M.I.Mech.E.

Discussion

Dr. F. C. Johansen said that the light, high-speed machine tool for rapid production was unquestionably of sufficient importance to justify the attention devoted to its design problems in the paper ; many users required tools to be as versatile as possible and to give efficient cutting conditions even for production in small quantities. Since an important proportion of this country's mechanical engineering output was carried out with general-purpose lathes, which were required to perform parting-off operations as well as plain turning and facing, he believed that the value of the paper to a good many engineers would have been enhanced had more consideration been given to parting tools and their associated fittings. It was not uncommonly the case with ordinary general-purpose lathes that satisfactory parting-off presented considerably more difficulty than other turning operations.

His remarks on parting-off were not intended to detract from the merits of carbide tools ; on the contrary, he could substantiate by experimental results the value of other factors than cutting performances. In particular, the improved surface finish could lead to a most important increase of fatigue strength. As one approach to the problem of locomotive tyre fractures, a considerable investigation had been carried out some time ago by the L.M.S. Railway research department to ascertain the influence on fatigue strength of alternative machined and other types of finish on the bore of locomotive tyres. Some typical results showed an improvement of about 50 per cent in bending fatigue strength in steels of 50–65 tons per square inch tensile strength, merely by machining the tyre bore with carbide tools instead of with high-speed steel tools.

Mr. J. Ferdinand Kayser expressed particular interest in the cutting side of the paper, as compared with the machine tool side, and referred to the author's statement that "the question of cutting tool life is intimately connected with the machinability of the material to be cut." No one, he said, would dispute that for a moment ; it seemed to him, indeed, that machinability and cutting efficiency were not fundamental properties of matter, and he did not think that whatever research was carried out and whatever else was done it would ever be possible to say that the machinability of a piece of steel was x and that the cutting efficiency of a tool was y. Whatever criterion of machinability was adopted was equally a criterion of the cutting efficiency of the tool which was being used at the particular time.

It was, apparently, suggested in the paper that when machining it was desirable to allow a temperature development, because this would soften the material which was being cut. He did not think, however, that the author meant that, because if so it was rather contradicted later on by what was said about coolants. The author said—and it was, of course, a fact—that a coolant did not make very much difference to tungsten carbide tools, but personally he thought that it was at any rate advantageous.

He did not think that the temperatures reached during cutting operations were really as high as many people imagined. He had measured them, and actually in cutting operations he did not think that the work ever reached a temperature of more than, say, 200 deg. Cent. The tool never became really hot, except perhaps back of the cutting edge, and even if the steelwork did reach a temperature of 300 deg. or 400 deg. Cent when working at high speed, that would not materially affect its physical properties.

In his opinion, tungsten carbide form tools were not difficult to grind. It was not possible to grind such tools quickly, and proper provision must be made for the operation ; diamond wheels must be used ; but it was a fact that it was possible to grind tungsten carbide more accurately and more precisely than steel.

Mr. R. R. Hutchings said he would have liked to have a little more of the author's experiences concerning the application of tungsten carbide to heavier machines, such as heavy planers and vertical boring mills. On each of these machines some people preferred a negative rake and some a positive rake. He had heard it claimed that high-speed steel was better than tungsten carbide on such machines. Whilst it was appreciated that high speeds with tungsten carbide were the best to obtain good cutting results, he had had experience of cases where for roughing it was best to use two tools following up closely and take a lighter cut, so relieving the load on each tool, whilst for planing (contrary to what had been said, and what was the case in many instances for finishing) a wide roughing tool with a coarse feed and lowering the speed had often been found better with tungsten carbide.

Mr. Cook said it was agreed that cutting tool performance had advanced generally, and in that connection there was much justification for the increased popularity of tungsten-carbide-tipped tools. Due, however, to relatively high servicing costs and the increased power required to drive the machines, it was sometimes difficult to absorb this technique into the framework of current production methods.

While everyone was very much impressed by the performance of carbide tools for light engineering work, there were not so many opportunities for taking full advantage of their superior cutting qualities. It was felt that in addition to the machine modifications dealt with in the paper there might be a case for the design of special-purpose machines for the rapid removal of stock without having to compromise in any way. Such machines would be of relatively simple construction, adequately powered, and probably of unorthodox appearance. Such machines would be invaluable for work within their scope—for handling large quantities of similar parts, for complete machining or preparation for finishing elsewhere.

Mr. H. Eckersley said it was time that the machine tool maker realised the limitations to the exploitation of tungsten carbides, and he had been very pleased to hear the author's comments on the capacity of the machine tool maker to meet some of the shortcomings in modern machine tools. Personally, he thought that the general tone of the discussion probably reproduced that of a discussion held in the lecture theatre of the Institution forty years ago, during the period of transition from tools of the Mushet type to high-speed steels. The machine tools of that day were completely incapable of exploiting high-speed steel satisfactorily, and so the machines were evolved up to the point of being able to use high-speed steel to its best advantage. To-day, industry was trying to use carbide tools on machines designed for high-speed steels, and expecting to obtain far better results.

Reference had been made to the temperature at the cutting edge. He would suggest that any work produced by any tool was efficiently cut only when the workpiece itself was perfectly cold after the cut had taken place. There should be no necessity to use a coolant of any kind in conjunction with any kind of tungsten carbide tool except where the coolant was used from the point of view of applying some external pressure for chip removal.

The next speaker, Mr. Harrison, said that tied up with the question under discussion was the cost of the reproduction of the tool, and the final criterion was what the article actually cost, not how long the particular tool lasted. If a tool lasted for only a short space of time, say, half an hour, but it was possible to renew it in five seconds, it would be a very economical tool, although its life was short, because the reproduction time was so short.

Mr. C. Eatough, in a preliminary reply, said that the outstanding point raised had been with regard to the parting tool, which was the bane of everybody's existence. He described a parting tool, used with a capstan lathe, which cut off 1¼in diameter 0·30 per cent carbon steel in three seconds, and would cut off 2in. diameter 0·30–0·40 per cent carbon material in seven seconds. Speed was the secret, together with a 45-deg. land all round the cutting edge. He thought that all the troubles which had been experienced with parting tools were due to low speed.

He agreed that coolants were not necessary on any carbide operation from the point of view of cutting, but they were necessary with some other tools on a combination and automatic lathe set-up, and a very important point to be considered was that of fire risk. If oil was used and carbide cutting was undertaken at the same time, there was a decided risk of fire, and the only way to handle that at present was to put plenty of oil on the carbide tools as well, in order to quench the chips. If hot chips were allowed to drop on to oily turnings, or if there was a very meagre supply of oil, there was a risk of fire.

Paper Mill Expansion

In addition to a 5,000,000-dollar post-war expansion programme, Pacific Mills Company, British Columbia, has announced an additional expenditure of 550,000 dollars for the expansion and improvement of its plant at Ocean Falls. About 130,000 dollars have been earmarked for the company's Ocean Falls kraft mill. The mill's present three 2½ tons capacity rotating digesters will be replaced by new digesters of 3½ tons capacity. The new digesters, which are being made in Vancouver, by the Vancouver Iron Works, Ltd., will be among the largest digesters now in use in the North American kraft paper industry. Other improvements planned for the Ocean Falls plant are new asbestos-lined aluminium section hoods for the plant's two high-speed newsprint paper machines, and an 80,000-dollar conversion job on the company's No. 6 pulp-drying machine.

Modern Cutting Tools and Machine Tool Design*

By C. EATOUGH, B.Sc.Tech., M.I.Mech.E.†

CUTTING tool research has for its object the reduction of the cost of production and accordingly the problems are to a great extent economic.

Rate of production is determined by the rate of feed and high cutting speeds have been developed in order to allow rapid feeding. As so many difficulties are associated with high speed machining, it might well be asked why rapid feeds were not used in conjunction with low cutting speeds. Heavy feeds at low speeds give rise to thick chips and heavy cutting loads. Frequently the rigidity of the work limits the permissible cutting load and heavy chip formation is always combined with poor surface finish quality.

Heavy cutting loads necessitate heavy machines and recent cutting tool research has tended to the development of the light machine running fast as distinct from the heavy, slow speed machine. Great accuracy of the product with good surface finishes are now required and both of these demand high speeds with relatively light cuts.

The history of machine tools shows that they have not created a demand but have been originated to meet a demand. Of late years there has been a large increase in the lighter production industries catering for the automobile, electrical, and domestic appliance trades and the calls of these industries for machine tools have contributed greatly to the growth of the light high-speed machine tool.

It is a large step from the realm of laboratory research to the application of the results to production, and this is true of recent work on cutting tools. Much investigatory work has been done both in this country and in America on the phenomena concerning the cutting of metals, and although considerable advance has been made in knowledge of the subject, many problems await solution before the full benefits can be handed on to the machine user. Good cutting performances are all very well in their way, but many machine tools are occupied in cutting for a surprisingly small proportion of the twenty-four hour day, and the benefits of enhanced cutting efficiency can easily be overwhelmed by the time required for tool setting, handling, loading, and machine maintenance. The machine designer must take account of these aspects of the problem as well as the cutting efficiency, if a satisfactory overall efficiency is to be obtained.

The story of the development of cutting tools is marked by several well-defined steps, which have each shown the necessity of improving the available machine tools to enable them to be used with the new types of cutting tools.

One of these steps was the introduction of high-speed steel, which, in a very short time, rendered obsolete most of the chip forming types of machine tools then in use, and revolutionised machine tool design. It is usual in such circumstances for the machine designer to make the new machine capable of complete mastery over the cutting tool, and in response to this new challenge still further improvements in cutting materials resulted. Subsequent development made slow but steady progress over a number of years until in 1927 the introduction of tungsten carbide tools caused another upheaval and once more placed the cutting material ahead of the machine.

Although tungsten carbide tools raised cutting speeds to figures thought unattainable, the change was not so sweeping as when high-speed steel was first made, since the inherent brittleness of the new material prohibited its use for certain operations which required a tool combining toughness with good cutting qualities.

On introduction, tungsten carbide was most used on cast iron and non-ferrous materials, and the brittleness of the new cutting tools restricted their use to light finishing operations as they were thought to be unsuitable for heavy roughing work.

Subsequent improvements in the quality of the cutting tools widened the range of application, but the brittle nature of the material still caused considerable trouble in an industry educated to the use of high-speed steel.

The provision of large section tool shanks and more rigid machines did much to overcome the early troubles and eventually it became general knowledge that high cutting speed was an essential condition for the successful use of the new material. The full significance of this fact seems not to have been appreciated for some considerable time. Tool troubles with high-speed steel were usually obviated by the use of reduced cutting speeds, but with the new material the opposite applied and increases in speed frequently gave better performances.

The question of cutting tool life is intimately connected with the machinability of the material to be cut. With the tungsten carbide tools it was possible to cut at considerably higher speeds than had been practicable when using high-speed steel. The speed range had been lifted to such an extent as to give an altered set of conditions obtaining at the tool nose.

With the new conditions, the temperature reached by the work and by the chips adjacent to the tool nose was very high indeed, so that local softening both of the work and the chips resulted. The softening gave the material the property of being machined more readily so long as the heating conditions were maintained. Very high speed cutting with high-speed steel tools soon gives rise to tool failure caused by local softening of the tool by heat, but carbide tools maintain their hardness at much higher temperatures and so can be run at correspondingly higher speeds. Unfortunately the property of maintaining hardness at high temperatures is always associated with lack of toughness.

TOOL PERFORMANCE

The separation of a chip by a cutting tool takes place in two stages; first the chip is sheared from the parent body and then it passes across the face of the cutting tool to escape, in the form of a completely separated piece of material.

Heat is generated by the initial rupture which takes place ahead of the tool nose and also by the friction of the passage of the chip across the tool face.

The higher the cutting speed, the greater the softening tendency and the more readily the material machines, if the tool edge maintains its hardness and shape.

Apart from breakages, tool failure usually takes two forms: wear on the nose clearance angle caused by the tool tip scraping on the machined surface below the chip, and wear on the tool face caused by the passage of the chip across it. High-speed cutting tends to aggravate both types of wear but attempts to increase resistance to wear usually lead to increased brittleness and make tools more prone to breakage.

The obvious development of using wear resisting but brittle material for the tips, and increasing the mechanical strength by change in design, led to low positive rake tools and eventually to negative rake tools.

Negative rake tools have been much to the fore in recent years, and it is unfortunate that such tools have been so named. No sudden change in cutting conditions occurs as the top rake of a positive rake tool is gradually reduced through zero top rake to negative top rake, although the use of the terms "positive rake" and "negative rake" tends to imply some radical change. There is very little connection between the wedge type of cutting tools, of which the pen-knife is a good example, and the shearing type of tool which is used almost universally for metal machining operations. Even high positive rake tools used for metal cutting operate principally by shearing, as also do the so called negative rake tools. This is a point which should receive attention when tool nomenclature is being considered, with the object of emphasising that there is no essential difference in operation.

The use of low top rake appears to encourage local softening of the work and of the chip adjacent to the tool nose, and so improves the machinability of the material if this can be softened readily by heat.

The impact of the new technique of cutting with low rake tools has been far reaching in its effects on machine design and operation.

The success of high-speed cutting of any material depends to a great extent on the facility with which the chips can escape from the cutting tool edge after they have been separated from the mass being machined. For this reason, simple forms of chips must be produced, the ideal being a simple ribbon chip. The greater the departure from this simple shape the greater the resistance to free chip flow. Chips from form tools, in which different portions of the same chip are flowing in different directions, create exceedingly high pressures on the cutting edge and, if sufficient time is not given for the chips to escape, the pressures may rise to dangerous proportions leading to tool failure. Time for the chips to flow is a most important requirement for any form cutting operation and is the reason why slow speeds are necessary for this work.

Consideration has to be given to this point in the design of machines on which straightforward turning has to be combined on one machine with the ability to carry out form cutting.

Simple tool shapes with carbide tools demand high operational speeds, but when form cutting such as threading has to be carried out on the same components, the speed has to be reduced to suit the more complicated form of chip produced by the threading dies. In threading work, high-speed cutting cannot be attempted, owing to the time required for the chips to flow in the multi-directional paths. Pressures are high and the utmost toughness is called for in the dies if breakage is to be avoided. In spite of the introduction of carbides for tools for general machining, the higher grades of steel tools have to be relied on for threading. The effect of this on machine design is that whilst there has been a great increase in the higher speeds used for turning, the lower speeds have not been raised to correspond. In fact, there has been a steady call for several years for lower and still lower screwing speeds to suit the demands of the aircraft industry for the use of higher quality steels for screwed components.

(To be continued)

* Abstracted from a paper presented to the Institution of Mechanical Engineers, on January 2, 1948

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British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1.

ROTARY SHAFT OIL SEAL UNITS AND RELATED DIMENSIONS

No. 1399. This new standard classifies oil seal units and gives a list of units for shaft diameters from 0·25in to 7·0in in conjunction with housing diameters from 0·75in to 8·0in. Limits and maximum corner radii in housings, shaft sizes, lead-on chamfers and relative positions of sealing lips are given. In preparing this standard, the dimension of bore of the housing into which the seal fits and the outside diameter of the rotating shaft where the sealing lip contacts have been taken as the basis for standardisation so that the standard actually defines the space into which the seal unit is fitted. This course has been adopted because the particular application of the seal unit will, to a large extent, control its internal construction and the material from which it is made. Price 2s. post free.

TERMS AND DEFINITIONS RELATING TO HEAT-TREATMENT OF STEEL

No. 1392. This standard includes a list of terms in general use throughout the steel industries relating to the heat-treatment of steel, and the definitions of these terms are specified. An appendix gives further details of the transformation ranges. Price 2s. post free.

Industrial and Labour Notes

Manufacturing Costs

An exhibition entitled "How Goes Britain" was opened by the Chancellor of the Exchequer, Sir Stafford Cripps, at Charing Cross Underground Station, on January 1st. The aim of the exhibition is to show graphically the present economic state of the country.

In the course of a speech at the opening ceremony, the Chancellor emphasised the urgent need for every invention, device and method of organisation that would enable manufacturing costs to be reduced. He said that already many of our exports were in jeopardy because of their high price, and rising prices and rising wages were an acute danger to the nation's whole economy. The true way to improve standards of living was so to increase productive efficiency that we could afford to reduce prices, while maintaining wage levels, and that, too, was the only way in which our position could be maintained in competitive world trade.

During the period of easy sales, Sir Stafford asserted, owing to the prevalence of the so-called sellers' market, we had been too apt to disregard the urgent need for economising in production costs, not by cutting wages and salaries, but by using better methods of production. A great deal was being done by some firms and some industries, but he thought a much greater drive towards increased efficiency was necessary. The cost factor, Sir Stafford observed, was of vital importance to our future, and it was up to every person to see that in his or her particular job there was no waste and no unnecessary use of labour or materials.

Personnel Management

It has been suggested in many quarters in recent years that good personnel management in industry is a basic need for making the best possible use of all available labour. It is also recognised that personnel departments can play a most important part in setting-up and maintaining satisfactory industrial relationships.

The Ministry of Labour has lately published some particulars of the work of the Personnel Management Branch which was set up within its Factory Department, two years ago, and says that its advisers have been able to assist many firms whose personnel departments, for one reason or another, have not been functioning too successfully. By discussions with the individual firm and assistance to its personnel officer, the Ministry's advisers, it is claimed, have often been able to contribute to the efficient working of the personnel department and also to help the establishment of good relationships.

Furthermore, the Ministry's personnel management advisers are available for consultation on specific problems concerning staff, such as the control of absenteeism, the calculation and reduction of labour turnover, and the selection and training of new employees. They have also rendered a good deal of assistance in the organisation in various parts of the country of refresher courses for personnel officers.

Nickel in 1947

In a letter circulated to shareholders, Mr. Robert C. Stanley, President of the International Nickel Company of Canada, Ltd., has reviewed the principal activities of the nickel industry in 1947, and has indicated that world deliveries of Canadian nickel in all forms continued to increase throughout the year.

Mr. Stanley's letter stated that Canadian nickel deliveries in all markets during 1947 approximated to those of the industry's greatest peacetime year of 1937, while deliveries in the U.S.A. and Canada, it was believed, would show an increase of about 50 per cent over 1937. Reference was also made to new trends in the consumption of nickel and its alloys, emphasis being given to the growing utilisation of high strength, low alloy steels, which has added materially to the overall consumption of nickel by the steel industry.

Steel Census

The Ministry of Supply has announced its intention of resuming its wartime custom of taking from users a census of receipts, consumption and stocks of steel. The census, it may be recalled, was discontinued on the termination of the war in 1945. It is explained that the changed pattern of demand by consumers, and the imminent revision of the iron and steel distribution scheme have led to the decision to resume the census at six-monthly intervals. As a matter of urgency, however, it is proposed to take a census of receipts and consumption of steel during the fourth quarter of 1947, and of stocks at December 31, 1947.

A request for the information will be sent to approximately 18,000 steel-using firms next week. The Ministry appreciates that the census will involve additional work on the part of steel consumers, but feels that the importance of ensuring a proper distribution of the available supplies of steel will be evident to all. The return has been kept to the simplest possible form, calling for the insertion of only six figures, and the Ministry says that its prompt despatch by industry will materially assist the bringing into force of the improved distribution scheme.

Changes in Wage Rates

Changes in rates of wages in various industries in the United Kingdom, which came into operation during November, are reported by the Ministry of Labour to have resulted in an aggregate increase of approximately £665,000 a week for about 1,560,000 workers. In addition, the hourly rates of a number of workers were increased, thereby giving the same weekly wages as before for a shorter working week. Amongst the groups of workers affected by these changes were those employed in coal mining and other forms of mining and quarrying, the building industry, civil engineering construction, and heating, ventilating and domestic engineering.

In coal mining, it will be recalled, there came into effect in November increases of 15s. a week in the national minimum wage for adult underground workers, and of 10s. for adult male surface workers, while the shift rates of day-wage men were increased by 2s. 6d. for adult underground workers and by 1s. 8d. for adult surface workers. In the building industry there were increases of 3d. an hour in the standard rates for craftsmen and 2½d. for labourers. The wage increase in civil engineering construction amounted to 2d. an hour for men.

In addition to these figures, the Ministry of Labour has published statistics relating to wage changes in the eleven completed months, January to November, 1947. During that period 4,632,500 workpeople received wage increases aggregating £1,637,200 a week. In the corresponding eleven months of 1946, the full-time wages of 7,600,000 workers were increased by amounts which totalled about £2,700,000 a week.

Selling Prices for Tin

The Ministry of Supply announces that in consequence of the recent settlement of the price for Bolivian tin, prices of tin metal in the United Kingdom have been adjusted from January 6th as follows:—Minimum 99 per cent up to under 99·75 per cent tin content, from £510 to £519 per ton f.o.b. U.K. port or delivered U.K. consumers' works. Prices of other grades have been correspondingly varied as follows:—Refined tin, 99·75 per cent minimum, from £513 10s. to £522 10s.; refined tin, 99·9 per cent minimum, in 28 lb ingots, from £518 to £527; grain bar tin, from £530 to £539; and granulated tin, from £535 to £544.

Consequent upon the settlement of the basis purchase price for deliveries of Bolivian tin from January 1, 1948, the Ministry has, as stated above, adjusted its selling price of tin in the United Kingdom. In order to conform to this new selling price the Ministry has also adjusted the purchase price of Nigerian ore by raising it, with effect from January 6th, from £477 to £485 10s. per ton of tin in ore f.a.s. Nigerian port.

The Year's Coal Output

Provisional figures, issued by the Ministry of Fuel and Power on Monday evening last, showed that in the week ended January 3rd, Britain's output of deep mined coal was 3,000,000 tons and that opencast production totalled 92,700 tons. In the preceding week ended December 27th, 2,523,100 tons of deep mined and 222,100 tons of opencast coal were produced. Coal output during 1947—a period of fifty-three weeks—therefore totalled 199,700,000 tons. Considerable interest has been evident in recent weeks as to whether or not the target of 200,000,000 tons for the year would be achieved, and in the weeks immediately preceding the Christmas and New Year holidays, output was maintained at a level exceeding 4,000,000 tons. In 1946, taking a fifty-three-week period to January 4, 1947, coal production amounted to 191,790,000 tons.

Hours of Labour

In conjunction with the changes in wage rates mentioned in a preceding note, the Ministry of Labour has stated that in the month of November last, alterations in hours of labour resulted in an average reduction of about 2¼ hours a week for approximately 52,000 workers. In the industries covered by the Ministry's statistics, there came into operation in the eleven months, January to November, 1947, changes in working hours which resulted in an average reduction of about 3½ hours a week for about 5,050,000 workers.

Trade Disputes

The latest issue of *The Ministry of Labour Gazette* records that in November last there were 143 industrial disputes which led to stoppages of work in the United Kingdom. In addition, fifteen stoppages which began prior to November were still in progress in the early part of that month. During November, approximately 42,000 people were idle through these 158 stoppages, and it is estimated that in all 179,000 working days were lost. In November, 1946, 214 stoppages of work occurred, involving 44,700 people and causing an aggregate loss of 133,000 working days.

With regard to the duration of the stoppages of work which occurred in November last, the Ministry of Labour says that 143 ended during the month. Of this total, 57 lasted not more than one day; 36 lasted two days; 11 lasted three days; 23 lasted from four to six days, and 16 lasted for more than six days. In the first eleven months of last year 1594 industrial disputes leading to stoppages of work were reported to the Ministry. They involved in all 604,000 workpeople and through them it is estimated that 2,355,000 working days were lost. Of these disputes, 977 occurred in the coal mining industry, involving 300,800 workers and causing an aggregate loss of 899,000 working days. The engineering industry accounted for 76 of the disputes, involving 27,400 workers, and causing a loss of 179,000 working days; 109 of the disputes occurred in the shipbuilding industry, involving 66,600 workers, and resulting in a loss of 314,000 working days; and 92 disputes took place in the iron and steel and other metal trades, rendering 15,600 people idle, and causing a loss of 43,000 working days. In the corresponding eleven months of 1946 there were 2117 stoppages of work through disputes, in which altogether 512,200 workers were involved, and through which 2,107,000 working days were lost.

French Engineering News

(From our French Correspondent)

PARIS, January 2nd

Technical applications for X-rays were described at a recent meeting of the Société des Ingenieurs Civils. To radiograph material which is thick, tubes working at over one million volts have been constructed. The possibility of constructing 5 million volt tubes is envisaged and also 10 to 20 million electron-volt betatrons. Instantaneous radiography can be obtained with these "lightning" X-rays and is used to study explosions, the motion of projectiles and the course of the reaction chain in the atomic bomb. The thickness of sheet metal produced by rolling mills can be controlled by X-rays, and also the homogeneity of alloys. The lead tetra-ethyl content of petrol can also be determined by radiography.

* * *

France has received the first of Britain's coal exports in a shipment of 3000 tons, which has arrived at Dieppe. Officials of the French Ministry of National Economy stated that regular shipments, averaging a total of 30,000 tons a month, will be made during the first four months of 1948.

Actually the 30,000 tons of coal a month from this country represents only a small proportion of France's coal imports, which amount to about 2,000,000 tons monthly. Most of this comes from the United States. Before the war British coal exports to France exceeded an average of 500,000 tons a month.

* * *

Owing to production losses caused by the recent strikes, allocations of steel to French industries will be reduced for the first quarter of 1948. Allocations will not be fixed until February 1st, and although the fourth quarter of 1947 will be used as a basis, only 50 per cent of the allocations will be made with certain exceptions. Taking these exceptions into consideration, the provisional allocation envisaged is 800,000 tons, to be distributed from January 1st, against 1,375,000 tons for the last three months of 1947. Output in the steel industry has increased compared with the period preceding the strikes, and provided there are no unexpected occurrences it is thought that the average quarterly allocations will be increased to 1,450,000 tons, against 1,400,000 tons in 1947.

* * *

The French hydro-electric equipment programme since the nationalisation of the industry is considerable and most of the firms involved have joined forces temporarily to assure the success of the work. The Ets. Schneider, alone, or in participation with other firms, supplied before the war the complete equipment of the Coindre and Maréges plants. Since the war, it has participated in the equipment of the Genissiat plant by supplying (with Vices-Lille), two 90,000 h.p., 150 r.p.m., turbines. It has also built two auxiliary 2500 h.p., 500 r.p.m. turbines and an order is now in hand for a 90,000 h.p. turbine. For the equipment of the Aigle plant, the company supplied two main 70,000 h.p., 187 r.p.m. turbines for a head of 80m. For a factory at Bordes, the company supplied two horizontal Francis 5750 h.p., 750 r.p.m. turbines, designed for a head of 125m.

* * *

Orders filled by the Société de Constructions Electriques de Jeumont during 1947 include the installation of electrical equipment in a cement works; two hydraulic turbines and a 12,500-kVA alternator; one 25,000-kVA, 220,000V transformer; three electric ovens (two of 10 tons and one of 20 tons capacity); two 1760 h.p., 3000V locomotives; three 15-ton locomotives; six 7-ton locomotives; 130 trolleybus engines; two 9000-kVA, 90,000V transformers; one 15-kVA, 90,000V transformer and mobile sub-station; three 19,500-kVA, 10,000/60,000V transformers; one 1300 h.p. rolling mill equipment; and eight 1650 h.p. motors.

Notes and Memoranda

Rail and Road

BRITISH RAILWAYS.—Under the Transport Act, 1947, the British Transport Commission took over the railway systems of this country on January 1, 1948. The method by which the railways will now be operated for the Commission by the Railway Executive was described in our issue of December 5, 1947. The railways have been divided into six regions, London Midland, North Eastern, Eastern, Western, Southern, and Scottish, and in the interests of historical accuracy, these designations will be used in future in any references we make to British Railways.

BICYCLE AND MOTOR CYCLE SHOW.—The British Cycle and Motor Cycle Manufacturers and Traders' Union is organising a bicycle and motor cycle show, to be held at Earl's Court, London, from November 18 to 24, 1948. The last show of the kind was held in 1938.

LONDON MIDLAND WAR WAGONS TO CARRY IRON AND STEEL.—Eighteen 35-ton "rectank" railway wagons, specially built for the wartime movement of armoured fighting vehicles, have been converted at the Earlestown works of the London Midland Region of British Railways into bogie bolster wagons and are now in service carrying iron and steel. This follows the conversion last August of fifty "warwell" wagons, built for transporting tanks, to vehicles specially adapted for the movement of steel rails for track renewals.

LONDON TRANSPORT'S GREENWICH GENERATING STATION.—London Transport has recently placed a contract with Gwynnes, Ltd., for the supply and erection of three motor-driven circulating water pumps for installation at its Greenwich generating station. The new equipment is required to replace three existing pumps which were originally installed over forty years ago, and the new plant will be of increased capacity in order to meet the greater output for which the station was being rehabilitated at the outbreak of war. Provision is also being made for replacing a fourth pump at a later date. Each new pump will be capable of delivering 20,000 gallons of water per minute, against a total head of 50ft, and will be driven by a variable speed, 400-V, 3-phase, electric motor of 400 b.h.p. capacity, whose maximum speed will be 425 r.p.m. The new plant is intended to provide a supply of cooling water for condensing the steam leaving three existing turbo-generators, which produce the electricity supply for driving trams and trolleybuses.

Air and Water

CHINESE AIRLINES.—A survey of China's air services has indicated that airlines are investing more in ground installations than in new craft, special emphasis being given to acquiring new radio equipment, more hangars and better workshops. Attention is also being given to the improvement of flying conditions and the better overhaul of all aircraft. A chain of radio stations is now being built up rapidly over the length and breadth of the country.

P. AND O. PASSENGER FLEET.—By the end of the summer of 1948 the P. and O. Company expects to have six more passenger liners back in regular service. They are the "Mooltan," "Maloja," "Ranchi," "Chitral," "Carthage," and "Corfu." These will be in addition to the "Stratheden" and "Canton," which are now running on the United Kingdom-India-Australia and United Kingdom-India-Far East services respectively, and the "Strathaird," which will shortly leave London for Australia on her first post-war voyage as a reconditioned passenger liner.

MERCHANT NAVY SCHOLARSHIPS.—Scholarships under the Drewry Fund for boys wishing to become deck officers in the Merchant Navy will again be awarded during the year to the sons of Merchant Navy, R.N., R.N.R., and R.N.V.R. officers and ratings who died or were seriously disabled by enemy action, or who were discharged on grounds of ill-health while serving in the war, or who are still serving. The scholarships are awarded at the Nautical College, Pangbourne, H.M.S. "Conway," H.M.S. "Worcester," T.S. "Mercury," and the School of Navigation, University College, Southampton, and applications should be made to the Principals of the Schools not later than April 30, 1948. Candidates for entry into the Nautical College, Pangbourne, and the T.S. "Mercury" must be thirteen or fourteen years of age, those for entry to H.M.S. "Conway" and H.M.S. "Worcester," fourteen or fifteen years of age, and candidates for the University College, Southampton, must be sixteen years of age.

Miscellanea

URANIUM PRODUCTION IN SWEDEN.—It is reported by *The Anglo-Swedish Review* that Sweden is planning an annual output of nine tons of uranium. It will be extracted from 3000 tons of radioactive slate derivative, but it is stated that plans have not yet passed the laboratory stage.

INSTITUTE OF METALS.—Dr. C. H. Desch, F.R.S., and Lieut.-Colonel Sir John Greenly, have been elected Fellows of the Institute of Metals. Professor Pierre Chevenard, Sir Geoffrey Ingram Taylor, F.R.S., and Dr. J. Fairfield Thompson, have been elected Honorary Members.

EMPLOYMENT IN ROYAL ORDNANCE FACTORIES.—The Minister of Supply says in a written reply, that the number of industrial employees in the Royal Ordnance factories at the end of November was 34,052. The number of non-industrial employees on the same date was 6669, of whom 1242 were established and pensionable.

TECHNICAL REPORT ON RUHR COALFIELD.—Another Appendix (No. 13A) to Volume III of the Technical Report on the Ruhr Coalfield has now been published by H.M. Stationery Office, price 9d. It contains a full description of a rotary rock-tunnelling machine, and discusses its manner of working and the possibilities of its use in coal mines.

NICKEL CAST IRON DATA BOOK.—A revised edition of its "Nickel Cast Iron Data Book" has now been issued by the Mond Nickel Company, Ltd. It has been arranged as a loose-leaf pocket book, and contains a great deal of information on technique, cupola practice, weights of charge, and many other points relating to the founding of the various types of nickel alloy cast iron now put to engineering uses.

THE INDUSTRIAL RESEARCH INSTITUTE.—Mr. Games Slayter, vice-president in charge of research and development of Owens-Corning Fiberglas Corporation, has been chosen to receive the 1948 Industrial Research Institute medal presented for outstanding contribution to the field of industrial research. The Institute, composed of ninety-three companies, representing diversified types of industry throughout the U.S.A., cited Mr. Slayter for his leadership in the development of glass fibres and their commercial application.

B.O.C. WELDING PRIZE.—The council of the British Welding Research Association has accepted an offer from the British Oxygen Company, Ltd., to provide a prize fund of £100 per annum for three years for a competition relating to welding. A single prize of £100 is offered in 1948 and will be awarded for the best paper submitted on a research into welding or its application. Papers will require to be submitted on or before September 30, 1948. Full particulars of the competition will be announced shortly.

FILMS ON STEEL TUBES.—Two sound films, entitled "Thro' the Mill" and "The Tube Age," have been produced recently by Stewarts and Lloyds, Ltd. The first depicts the production of iron and steel, and then portrays the various processes by which steel tubes are manufactured. The continuous-weld process and the manufacture of seamless tubes by the push-bench process are described in detail, and tube production by the firm's hydraulic lapweld process is also illustrated. The second film deals impressively with the many and varied applications of steel tubes in present-day industry, public works, transport and domestic requirements. Each film runs for approximately thirty minutes, and 35-mm and 16-mm copies of both are available on loan from Stewarts and Lloyds, Ltd., Publicity Department, Brook House, Upper Brook Street, London, W.1.

BRITISH INDUSTRIES FAIR.—The Board of Trade says that the demand for space at the 1948 British Industries Fair has been exceptionally heavy and both the London and Birmingham sections now have a waiting list of late applicants. Total space applied for to date in the London Section is 684,000 square feet, which compares with the total area of 531,000 square feet available at the last fair. That figure, however, will show a slight increase in 1948 owing to an alteration in the space devoted to display features and in the rearrangement of gangways at Earl's Court. A similarly heavy demand has been experienced by the Birmingham section, which has a waiting list of 627 firms, including 385 definite applications for 99,000 square feet of space. There will be over 3000 exhibitors representing at least eighty-seven United Kingdom industries at the Fair, which will be held simultaneously in London and Birmingham from May 3rd to May 14th.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

To-day, Jan. 9th.—LIVERPOOL BRANCH: Electric Supply Company Showrooms, Whitechapel, Liverpool. "Light and Colour," Mr. Ablett. 6 p.m.

Wednesday, Jan. 14th.—BRADFORD BRANCH: Midland Hotel, Bradford. "Electrical Equipment of Machine Tools," C. Rhodes. 7 p.m.

Thursday, Jan. 15th.—SOUTH LONDON BRANCH: Cafe Royal, North End, Croydon. "Factory Maintenance (Mechanical)," J. M. Williams.

Bradford Engineering Society

Monday, Jan. 19th.—Technical College, Bradford. "History and Development of the Diesel Engine," J. Whitaker. 7.15 p.m.

Diesel Engine Users Association

Thursday, Jan. 15th.—Caxton Hall, Caxton Street, S.W.1. "Porous Chrome Hardening of Diesel Engine Cylinders," C. D. B. Williams. 2.30 p.m.

Illuminating Engineering Society

To-day, Jan. 9th.—Imperial Hotel, Temple Street, Birmingham. Annual dinner. 6 p.m.

Friday, Jan. 16th.—BIRMINGHAM CENTRE: Imperial Hotel, Temple Street, Birmingham. "Recent Applications of High Speed Flash Discharge Tubes," C. R. Bicknell. 6 p.m.

Incorporated Plant Engineers

To-day, Jan. 9th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham. Annual General Meeting. 7.30 p.m.

Tuesday, Jan. 13th.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester. Annual General Meeting. 7.15 p.m.

Thursday, Jan. 15th.—LIVERPOOL BRANCH: Temple (Liverpool Engineering Society), Dale Street, Liverpool. Annual General Meeting. 7.30 p.m.

Institute of British Foundrymen

Saturday, Jan. 10th.—NEWCASTLE BRANCH: Neville Hall, Newcastle-upon-Tyne. Past-President's night. 6 p.m.—SCOTTISH BRANCH: Royal Technical College, George Street, Glasgow. "Mechanised Bath Production," R. S. M. Jeffrey. 3 p.m.

Monday, Jan. 12th.—SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield. "The Use of Fulbond in Foundries," L. Roy. 7.30 p.m.

Tuesday, Jan. 13th.—WEST RIDING OF YORKS BRANCH: University, Leeds. "Improvements in Conditions and Amenities in Foundries," H. Berry. 7 p.m.

Thursday, Jan. 15th.—LINCOLN SECTION: Technical College, Lincoln. "Venting of Cones and Moulds," D. Killingworth. 7.15 p.m.

Friday, Jan. 16th.—MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. Film on "The Production of High Quality Steel," presented by W. H. Salmon. 7 p.m.

Institute of Economic Engineering

Friday, Jan. 16th.—Cowdray Hall, Henrietta Place, W.1. Annual General Meeting. 7.15 p.m.

Institute of Marine Engineers

Tuesday, Jan. 13th.—85, Minories, E.C.3. "Sea Water Contamination of Boiler Fuel Oil and its Effects," C. J. Gray and W. Killner. 5.30 p.m.

Institute of Metals

Tuesday, Jan. 13th.—SWANSEA SECTION: Metallurgy Department, University College, Swansea. Industrial Films. 6.30 p.m.

Institute of Navigation

Friday, Jan. 16th.—Royal United Services Institution, Whitehall, S.W.1. "Grid Navigation and its Allied Problems," R. H. Blackmore. 5.30 p.m.

Institute of Petroleum

Wednesday, Jan. 14th.—26, Portland Place, W.1. "The Structure and Properties of Ethylene Polymers," R. B. Richards. 5.30 p.m.

Institute of Welding

Monday, Jan. 19th.—NORTH LONDON BRANCH: Manson House, 26, Portland Place, W.1. "The Welding of Bridges and Buildings," S. M. Reisser. 7.30 p.m.

Institution of Chemical Engineers

Tuesday, Jan. 13th.—Burlington House, Piccadilly, W.1. "Detergency," B. Edgington. 5.30 p.m.—Geological Society, Burlington House, Piccadilly, W.1. "Chemical Engineering Aspects of Handling Sterile Medical Products," B. Edgington. 5.30 p.m.

Institution of Civil Engineers

Tuesday, Jan. 13th.—Great George Street, S.W.1. Talk and Film: "Swedish Bridge Construction and the Sando Bridge," Sven Klingberg. 5.30 p.m.

Institution of Electrical Engineers

Monday, Jan. 12th.—NORTH-EASTERN CENTRE: Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Comparison Between Gas and Electricity on the Basis of Coal Economy," P. Schiller. 6.15 p.m.—LONDON STUDENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Place of the Engineer in the Postwar World," Sir Arthur Fleming. 7 p.m.

Tuesday, Jan. 13th.—NORTH MIDLAND CENTRE: Corporation Electricity Department, Whitehall Road, Leeds. "Neutral Earthing of Three-phase Systems, with Particular Reference to Large Power Stations," J. R. Mortlock and E. M. Dobson. 6.30 p.m.

Wednesday, Jan. 14th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2. "Reference-Crystal-Controlled V.H.F. Equipments," D. M. Heller and L. C. Stenning. 5.30 p.m.—SCOTTISH CENTRE: Heriot-Watt College, Edinburgh. "The Teaching of the Principles of Electrical Machine Design," L. H. A. Carr. 6 p.m.

Thursday, Jan. 15th.—ORDINARY MEETING: Savoy Place, Victoria Embankment, W.C.2. "Standardisation of Switchgear," D. E. Lambert and J. Christie. 5.30 p.m.

Saturday, Jan. 17th.—NORTH MIDLAND STUDENTS SECTION: Electricity Department, Whitehall Road, Leeds, 1. Main Centre Chairman's Address, E. S. Ritter. 2.30 p.m.

Institution of Heating and Ventilating Engineers

Monday, Jan. 12th.—MANCHESTER AND DISTRICT BRANCH: Milton Hall, Deansgate, Manchester. "Air Conditioning Plant for Cotton Mills," A. Leslie Longworth. 7 p.m.

Institution of Locomotive Engineers

Wednesday, Jan. 14th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1. "Southern Railway All-Steel Suburban Electric Stock," L. Lynes and C. A. Shepherd. 5.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 9th.—Storey's Gate, St. James's Park, S.W.1. "The Design of Contra-Flow Heat Exchangers," Ernst Schmidt. 5.30 p.m.

Friday, Jan. 16th.—Storey's Gate, St. James's Park, S.W.1. "The Screen in Relation to Engineering Training," H. R. Hockley. 5.30 p.m.

Institution of Mining and Metallurgy

Thursday, Jan. 15th.—Geological Society, Burlington House, Piccadilly, W.1. "The Mechanisation of Iron Ore Mining at the Mines of Richard Thomas and Baldwins, Ltd.," W. E. Davies. 5 p.m.

Institution of Production Engineers

Monday, Jan. 12th.—HALIFAX SECTION: White Swan Hotel, Halifax. "Britain's Industrial Future," Lewis C. Ord. 7 p.m.—LUTON AND DISTRICT SECTION: Town Hall, Luton. "Press Work," Mr. Grainger. 7 p.m.—DERBY SUB-SECTION: Art School, Green Lane, Derby. "Making a Typewriter," R. M. Evans. 6.45 p.m.

Tuesday, Jan. 13th.—BIRMINGHAM GRADUATE SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Mechanical Handling in Factories," H. M. King. 7.15 p.m.

Wednesday, Jan. 14th.—LONDON GRADUATE SECTION: Central Hall, Westminster, S.W.1. "Production Incentive Systems," A. Gordon. 7 p.m.—LUTON AND DISTRICT GRADUATE SECTION: Midland Hotel, Luton. "Efficient Tooling for Production," B. Holloway. 7.30 p.m.

Thursday, Jan. 15th.—GLASGOW SECTION: Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2. "Cold Upsetting and Thread Rolling," T. C. Parker. 7.30 p.m.—MANCHESTER GRADUATE SECTION: College of Technology, Sackville Street, Manchester. Film on "Metal Spraying," W. E. Ballard. 7.15 p.m.—LEICESTER SECTION: College of Technology, The Newarke, Leicester. "X-Rays in Industry," R. H. Herz. 7 p.m.

Institution of the Rubber Industry

To-day, Jan. 9th.—Bell Hotel, Humberstone Gate, Leicester. "Libraries and the Handling of Technical Information in the Rubber Industry," G. A. Shires. 7.30 p.m.

Monday, Jan. 12th.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Man-Made Fibres in Tyre Castings," J. W. Illingworth. 7.15 p.m.

Institution of Structural Engineers

Wednesday, Jan. 14th.—LANCASHIRE AND CHESHIRE BRANCH: College of Technology, Sackville Street, Manchester. "Manufacture and Uses of Asbestos Cement Materials," T. S. Drinkwater. 7 p.m.

Junior Institution of Engineers

To-day, Jan. 9th.—39, Victoria Street, S.W.1. "Gas Turbine Power Plants for Aircraft Propulsion," R. M. Cracknell. 6.30 p.m.

Monday, Jan. 12th.—NORTH WESTERN SECTION: Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester. "Some Notes on the Production of Alternating Current Circuits," H. H. Daniels. 7 p.m.

Tuesday, Jan. 13th.—WESTERN GROUP: Grand Hotel, Broad Street, Bristol. "Electrical Equipment of Automobiles," J. Bebbington. 7.30 p.m.

Keighley Association of Engineers

To-day, Jan. 9th.—Devonshire Buildings, Devonshire Street, Keighley. "Diesel Engines," J. Whitaker. 7.30 p.m.

Manchester Association of Engineers

To-day, Jan. 9th.—College of Technology, Sackville Street, Manchester. "Researches now in Progress in the Cavendish Laboratory," Sir Lawrence Bragg. 7.30 p.m.

Newcomen Society

Wednesday, Jan. 14th.—Science Museum, South Kensington, S.W.7. "Sir John Barton's Iris Ornaments," P. Grodzinski. 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Jan. 9th.—Mining Institute, Newcastle-upon-Tyne. "Design of Marine Heating and Ventilating Systems in Accommodation," R. McDonald. 6.15 p.m.

Royal Aeronautical Society

Thursday, Jan. 15th.—Institution of Civil Engineers, Great George Street, S.W.1. "Gas Turbine Accessory Systems," O. N. Lawrence. 6 p.m.

Women's Engineering Society

Saturday, Jan. 10th.—MANCHESTER BRANCH: Visit to Fowlers (Calculators), Ltd. 2.30 p.m.

Personal and Business

LIEUT.-COLONEL R. D. HESELTINE has been appointed general manager of Dawnays, Ltd.

THE MAVITTA DRAFTING MACHINES, Ltd, has moved to Highlands Road, Shirley, Birmingham.

THE BRITISH TRANSPORT COMMISSION announces the appointment of Mr. C. Barman as publicity officer.

MR. ALASTAIR C. CROCKATT, A.M.I.Mech.E., has been appointed a director of William Crockatt and Sons, Ltd.

MR. H. BUTTERWORTH has been appointed managing director of the Edison Swan Electric Company, Ltd.

CAPTAIN C. J. CLUTTERBUCK has been appointed Marine Superintendent of the Union Castle Line at Port Elizabeth.

MR. W. B. BAXTER, general manager of the Appleby-Frodingham Steel Company, has been appointed a director of the United Steel Companies, Ltd.

HORSELEY BRIDGE AND THOMAS PIGGOTT, Ltd., announces the retirement of Mr. Leonard Harper, a director, after forty-three years' service with the company.

THE FORD MOTOR COMPANY, Ltd, announces the appointment of Mr. Frank Daniels, M.I.B.A.E., as sales manager for tractors and agricultural machinery.

THE INSTITUTE OF TRANSPORT states that its address is now 80, Portland Place, London, W.1 (telephone, Welbeck 2216; telegrams, Transitute, Wesdo, London).

DR. T. HOWARD BUTLER has been elected president of the British Tar Confederation, and Mr. R. Alsop has been elected chairman of the executive board.

THE ASSOCIATION OF SUPERVISORY STAFFS, EXECUTIVES AND TECHNICIANS has changed its address to 110, Park Street, London, W.1 (telephone, Mayfair 8541).

MR. W. LIONEL FRASER has been elected a director and deputy chairman of Tube Investments, Ltd. Sir Edmund Crane has resigned from the board of the company.

MESSRS. MORRISON, MARSHALL AND HILL, 44–45, Tower Hill, London, E.C.3, inform us that they are now responsible for the London and export interests of Graham and Normanton, Ltd., Halifax.

THE FORD MOTOR COMPANY, Ltd., announces that, in co-operation with F. Perkins, Ltd., the Perkins "P6" diesel engine is now obtainable as an alternative power unit for the "Thames" range of vehicles.

THE BRITISH ALUMINIUM COMPANY, Ltd., states that its Midland warehouse is now in operation at 17–18, Providence Street, Cradley Heath, Staffs (telephone, Cradley Heath 6881). The company's Midland Branch office remains at Lansdowne House, 41, Water Street, Birmingham, 3.

RICHARDSONS WESTGARTH AND CO., Ltd., announces that Mr. T. P. Everett, until recently manager of the land department of the Hartlepool works, has been appointed a director. Mr. B. B. Wyatt has been appointed manager of the land department. Mr. W. E. Loveridge continues as resident director in charge of the Hartlepool works.

WILD-BARFIELD ELECTRIC FURNACES, Ltd, announces the formation of Indian Wild-Barfield Company, Ltd., to cover sales and services of Wild-Barfield furnaces and equipment in India and Pakistan and adjoining countries. The local management is under the control of Mr. R. A. P. Misra, and the company's officers are at Fort Chambers, 6-10, Dean Lane, Hammam Street, Fort, Bombay.

THE FAIREY AVIATION COMPANY, Ltd., announces that Mr. W. W. MacArthur, M.I.Mech.E., M.I.P.E., has left its services to take up an appointment as Managing Director of Air Ducts, Ltd., of Brentford, Middlesex, the principal subsidiary of Richard Crittall and Co., Ltd. Mr. MacArthur has also been appointed Executive Director of the Glasgow factories of Richard Crittall and Co., Ltd.

Calendars and Diaries

WE acknowledge receipt of calendars and/or diaries for 1948 from the undermentioned firms:

SWEDISH LLOYD, Gothenburg, Sweden.

BRITISH BROWN-BOVERI, Ltd., London, S.W.1.

C. A. PARSONS AND CO., Ltd., Newcastle upon Tyne.

THE BUTTERLEY COMPANY, Ltd., 2, Caxton Street, S.W.1.

BROOKHIRST SWITCHGEAR, Ltd., Northgate Works, Chester.

JOHN S. YOUNG AND CO., Ltd., 68, Gordon Street, Glasgow, C.1.

THE BRITISH VACUUM CLEANER AND ENGINEERING COMPANY, Ltd., Leatherhead, Surrey.

A Seven-Day Journal

The Shipbuilding Industry's Steel Cut

In his survey of the steel situation—to which reference is made on another page of this issue—Sir Stafford Cripps stated that the 1948 steel allocation to the shipbuilding industry would be cut by "something approaching one-fifth of the 1947 deliveries." Commenting on the serious repercussions of this decision, Sir Frederick Rebbeck, chairman of Harland and Wolff, Ltd., said early this week that the reduction might make it impossible for his company to fulfil its large orders for ships for export, and might even render it unable to complete ships now on the stocks. So far as Belfast was concerned, Sir Frederick expressed the view that the steel cut would lead to unemployment in a place where no alternative employment could be found for men within easy reach of their homes. A 20 per cent steel reduction must mean 20 per cent less production, 20 per cent less export, and 20 per cent less employment at a time when the yards were full of export orders for ships. Officials of the Shipbuilding Conference have also commented during the week on the reduction in the quantity of steel to be made available for shipbuilding. They pointed out that shipbuilders were being pressed by the Government mission in Argentina to take additional orders for ships, and were also being urged to consider giving Russia part of the British output.

British Engineers Association

At the meeting held on Thursday of last week, January 8th, the governing council of the British Engineers' Association elected as President Mr. C. K. F. Hague, M.I.Mech.E. Mr. Hague is managing director of Babcock and Wilcox, Ltd; director of Edwin Danks and Co. (Oldbury), Ltd., and the Société Francaise des Constructions Babcock and Wilcox; chairman of Société Belge Babcock and Wilcox (S.A.), and director of Babcock and Wilcox of Africa (Pty.), Ltd., and Babcock and Wilcox and Goldie McCulloch, Ltd., Canada. He is also a member of the Engineering Advisory Council; the management board of the Engineering and Allied Employers National Federation; the council of the Institution of Mechanical Engineers; the grand council of the Federation of British Industries; the Industrial Coal Consumers Council, and the heavy electrical plant committee of the Ministry of Supply. In 1941 Mr. Hague was appointed one of the management representatives of the British industrial delegation to the U.S.A., and in 1944 was appointed to Washington as the British representative of the public utilities committee, Combined Production and Resources Board.

Profit-Sharing in Co-operative Productive Societies

Figures issued by the Co-operative Productive Federation on the working of its associated societies during 1946 include details of seven organisations in the Miscellaneous Trades Group, in which section are placed the societies engaged in the engineering and allied industries. At the end of 1946 the seven societies had a membership of 1020, with a share and loan capital of £65,409. They had a turnover of £345,318 and employed 662 workers, who received £168,382 in wages during the year. With one exception, for which the statistics are incomplete, all the societies had a surplus on their working during the twelve months. It totalled £22,514. Of this sum £433 was paid by three societies to their shareholders, £16,914 by five societies to labour, and £267 by two societies to customers. Four societies made grants to educational and benevolent funds totalling £749 among the engineering concerns. Walsall Locks and Cast Gear, Ltd., had a surplus of £17,157 out of which £308 (1 per cent) was paid to capital and £15,500 (15 per cent) to its employees; the Leicester Carriage Builders and Wheelwrights, Ltd., with a surplus of £2160, declared bonuses amounting to £94 (2½ per cent), £325 (3¼ per cent), £250 (1¼ per cent) to its shareholders, workers and customers respectively; and the East London Toy Factory, Ltd., out of a credit balance of £1569, allocated £245 to its workpeople, but passed over its shareholders and customers. A comparatively newcomer to this annual report is the Documentary Technicians' Alliance, Ltd. (a film-producing society, known by the initials DATA), which was registered as a co-operative productive society in 1944. At the end of 1946 it had twenty-nine members, a share and loan capital of £2115; its twenty-one employees receiving £10,520 in wages. It secured business valued at £23,515, and had a net surplus of £332, all of which was placed to reserve.

A Vickers-Armstrongs-Sulzer Rail Traction Agreement

It is announced by Vickers-Armstrongs, Ltd., and Sulzer Bros. (London), Ltd., that an agreement has just been concluded under which Vickers-Armstrongs, Ltd., will manufacture Sulzer engines for locomotives and other rail traction services at their Barrow-in-Furness works. Under the agreement, all questions of sales and co-ordination of design of the complete vehicles will be handled by Sulzer Bros. (London), Ltd. Sulzer engines have been in use in traction service for a longer period than most other types of heavy oil engine and the latest design is based on the results of thirty-five years of experience in traction service, and over fifty years of heavy oil engine development. Vickers-Armstrongs, Ltd., as a result of its long experience of the manufacture of high-speed engines for naval service, is in an unrivalled position to produce an engine of the very high quality required to meet the arduous demands of rail traction service. The first engines to be manufactured under the new agreement will be fitted into six 1830 b.h.p. express locomotives for the Coras Iompair Eireann (Eire), to be used mainly on the Dublin-Cork service.

Thames Flood Lands

At a meeting of the Thames Conservancy Board on Monday last, January 12th, it was stated that plans had been made for the control of building and development in areas in which flooding is likely. The particular areas were to be designated "Thames riverside lands," and local authorities were to be requested to prohibit all future building and any development inimical to the free passage of flood waters in such areas, and, as far as possible, to prohibit the rebuilding of existing properties thereon. We may recall that the delineation of a flood zone on each side of the river throughout its length was suggested by the chief engineer to the board last July, as the most practical method of dealing with floods. Sir Jocelyn Bray, chairman of the board, in his annual review of the board's activities, said that the board's programme of works was limited to an expenditure of £80,000, which was insufficient for the proper maintenance of the river and the renewal of defective structures. Local authorities were not being allowed to carry out major sewage disposal schemes and consequently sewage works were continuing to deteriorate. The board was concerned at the possibility of serious conditions arising. Extensive land drainage operations had been carried out and it was gratifying to note, Sir Jocelyn continued, the beneficial effect it had had in the interests of farming. About 288,500 cubic yards of material had been dredged, apart from that carried out by county agricultural committees on behalf of the board. Expenditure on this work totalled more than £155,000. Net expenditure for the year was estimated at £251,362. Rainfall in the Thames catchment area in 1947 amounted to 23·8in—the lowest since 1933—compared with the normal figure of 28·2in. But the total amount of water going over Teddington weir during the year was about 660,000 million gallons—equivalent to a 12in layer of water over the whole catchment area, compared with the normal 9in. The run-off was 50·5 per cent, as against a normal 31·8 per cent.

Bursaries for Young Engineers

With the aim of giving able young men opportunities to widen their experience and develop their talents, the firm of Crompton Parkinson, Ltd., of Astor House, Aldwych, London, W.C.2, has introduced a scheme to provide bursaries annually for selected applicants. This scheme, which is intended as a practical commemoration of the two founders of the company—the late Colonel R. E. B. Crompton and Frank Parkinson—comprises two distinct kinds of bursaries: "Crompton bursaries" for the company's employees in Great Britain, and "Parkinson Empire bursaries" for engineering graduates domiciled in Australia, New Zealand, and India. The training of young engineers was always a matter close to the heart of Colonel Crompton. It is appropriate, therefore, that his name should be associated with bursaries which will allow employees of exceptional promise to prepare themselves for advancement in the company's service by continuing their studies or by gaining further experience in the field of commerce or industry. There will be no limitations on the kind of facilities that will be offered, and the arrangements will be sufficiently flexible to suit each individual recipient of a bursary. Adequate financial provision will be made to allow the holder to pursue the course of study, conduct the research, or acquire the special experience that will help to make the most of his talents. The Parkinson Empire bursaries, for their part, form a particularly apt tribute to the memory of Frank Parkinson and his devotion to the cause of Empire development and closer co-operation between the Dominions and Great Britain. Accordingly, the Parkinson Empire bursaries will give to engineering graduates of Australia, New Zealand and India, the chance of obtaining technical training and practical experience in the workshops and laboratories of Crompton Parkinson, Ltd., in Great Britain. Normally, this period of training will be for two years, but in approved cases an extension may be granted to allow the holders to complete an engineering degree course in an approved British university or technical college.

The British Association

At a meeting of the British Association for the Advancement of Science, held in London on Friday last, Sir Henry Tizard, F.R.S., was installed as President in succession to Sir Henry Dale, O.M., F.R.S. Sir Henry Tizard, it will be recalled, holds several important scientific appointments, amongst them being the chairmanship of the Advisory Council on Scientific Policy, the Defence Research Policy Committee, and the recently constituted committee on Industrial Productivity. From 1927 to 1929 he was Permanent Secretary of the Department of Scientific and Industrial Research. In 1929 Sir Henry was elected Rector of the Imperial College of Science and Technology, an office which he relinquished in 1942 on becoming President of Magdalen College, Oxford. He has also served as chairman of the Aeronautical Research Committee, and from 1941 to 1943 was a member of the Air Council. Preliminary plans for this year's British Association meeting were also discussed last Friday. The meeting is to be held at Brighton from September 8th to 15th, and it is understood that scientific matters bearing on the economic crisis will have a prominent place in the programme.

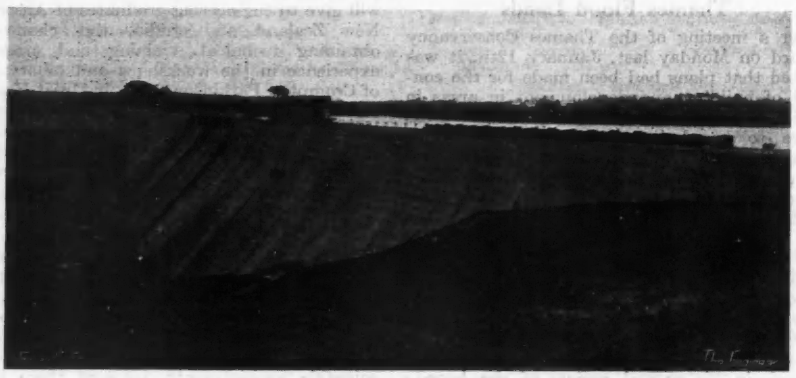
Civil Engineering in 1947

No. I

THOUGH still beset with shortages of labour and material, the civil engineering and contracting industry during the past year may, we think, be stated to have got into its stride. With the more important public works, such as water supplies, urgent railway works, and the construction of power and hydro-electric stations, good progress was evident. But arrears of maintenance on existing works and the competing demands for labour for the housing programme and for the rehabilitation of bomb-damaged premises prevented the starting of many schemes, to which we must still look forward.

The changes in the economic state of the country during 1947 were widely felt, either directly or indirectly. The coal shortage of last winter, apart from its other effects, delayed the delivery of materials to civil engineering sites, and later in the year it was made known that a number of schemes which had been approved and were about to be started would have to be postponed because of the necessity to cut our capital expenditure. Amongst these works were such projects as the Severn Bridge; most of the improvements scheduled for our highway system; a postponement of the construction of certain generating stations formerly scheduled for starting within the next three or four years; and many other schemes which are highly desirable. The truth of the matter is, as always, after a prolonged war, that the simultaneous completion of so many accumulated urgent requirements is not possible and a hard choice has to be made.

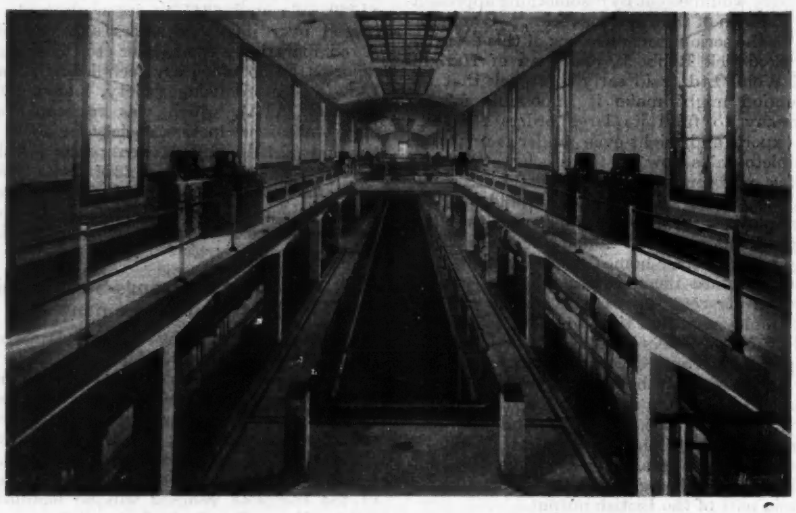
In the review which we start below we refer briefly to certain civil engineering works at home and abroad, which seemed to have reached an interesting state of progress. As always, pressure on the space available has crowded out many references which we would like to have made.



ST. SAVIOUR'S DAM, GUERNSEY, NEARING COMPLETION

Water Supply Schemes at Home

Because of the considerable changes in the distribution of the population and because of the almost complete cessation of work on water supply schemes during the war, the provision of new and the augmentation of existing water supplies was perhaps, in 1947, the most important work of the civil engineer. Many works were in progress all over the country but few were spectacular enough to warrant individual description in such a review as this. With the larger schemes, such as those involving the construction of dams, preliminary work, the provision of accommodation for workpeople, and the construction of access roads were frequently all that can be recorded as progress.



CONTROL HOUSE, M.W.B, HAMPTON PRIMARY FILTERS

Claerwen Dam

Water supplies for Birmingham are a case in point. That city obtains its water from gathering grounds in mid-Wales, from the upper reaches of the Rivers Elan and Claerwen. Here the rainfall averages 69·4in, and the catchment is more than 45,000 acres, giving a daily yield of 140 m.g. Three reservoirs already constructed have a combined capacity of more than 11,000,000 gallons. To augment this storage, a scheme for damming the River Claerwen was approved in 1940, but, because of the war, a start was not made until July, 1946. So far the preliminary work of establishing a power station, workmen's camps, site offices, and roads, and the opening up of a quarry has occupied most of the contractors' time, but soft and rock excavations for the dam foundations were begun by the end of the year. Progress was held up by long delays in the delivery of the essential heavy plant for cableways, crushers and mixers.

Claerwen dam will, when completed, in it is hoped some four years' time, be the largest of its kind in the country, rising to 182ft and with a length of 1066ft. It will hold up 10,860 million gallons, equivalent to 226 days' supply at the present rate of consumption. The laying of an additional 60in main to bring the water 73 miles to Birmingham is shortly to be started and application has been made to the Ministry of Health for permission to improve and extend plant at Frankley waterworks, Birmingham, by the construction of forty rapid gravity filters, each having a daily capacity of 2,000,000 gallons. The chief engineer of the Birmingham Water Department is Mr. C. A. Risbridger, M.I.C.E.; the engineers for the construction of the dam are Sir William Halcrow and Partners; and the contractors are Edmund Nuttall, Sons and Co. (London), Ltd. A description of the dam was published in our issue of December 6, 1946.

St. Saviour's Dam, Guernsey

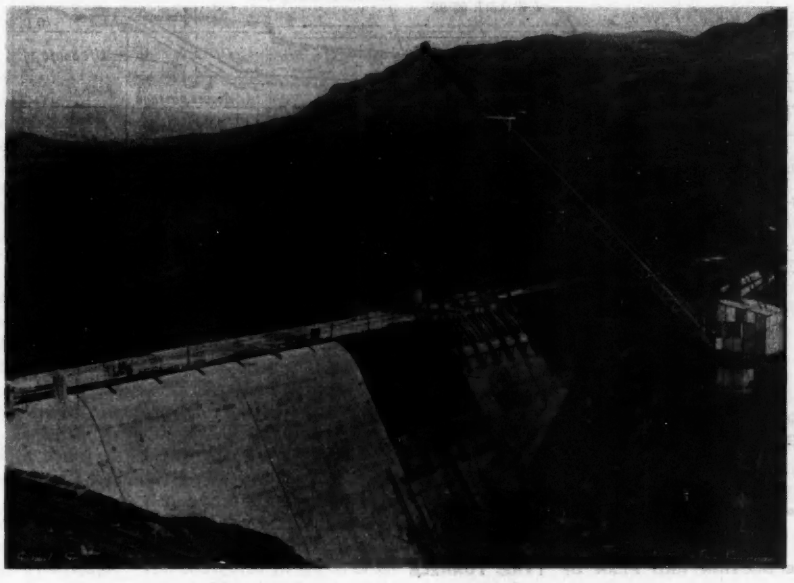
Work on St. Saviour's Dam, Guernsey, which was resumed in 1946, was completed in 1947. A brief description of this water supply scheme was included in our issue of January 17, 1947. Except for the prevalent scarcity of labour and materials no undue difficulty was experienced in completing the work. The photograph reproduced herewith, taken last April, shows the dam and reservoir shortly before completion. Work is now proceeding on the construction of a pumping station at the foot of the dam. The joint engineers are Sir William Halcrow and Partners, and Messrs. T. and C. Hawksley, and the contractors are Pauling and Co., Ltd.

Metropolitan Water Board

One of the events of the year was the inauguration by H.M. the King, accompanied by H.M. the Queen, of a new reservoir at Staines last November, and its naming, "King George the Sixth Reservoir." A fully illustrated description appeared in our issue of November 14, 1947. The purpose of the Staines Works, to which the new reservoir is an addition, is to store water abstracted from the Thames during periods of high flow for use at times of low flow. The new reservoir has a capacity of 4400 million gallons; it is 2037 yards long and its width varies from 722 yards to 962 yards, giving a water surface of 350 acres, about the

same area as that of Hyde Park. The average depth of the water is 52ft. The reservoir was constructed to the designs of Sir Jonathan Davidson, M.Sc., M.I.C.E., who, first as chief engineer to the Metropolitan Water Board and later as engineer for the construction of major works, was responsible for all stages of its construction.

Work was carried forward by the Board on the improvement of a large number of its stations and works, but detailed descriptions must await a longer article than this review. To refer but briefly to one of these schemes, we illustrate on page 58 the interior of the primary filter control house at Hampton Works. Thames water is filtered and pumped into supply at these works, which date from 1852, and are the largest operated by the Board. To increase the capacity of the station from about 55,000,000 gallons per day to 120,000,000 per day, a large scheme of remodelling was begun shortly before the war. A new engine-house was finished and set to work before the outbreak of hostilities, but the remainder of the scheme was seriously delayed during the war period. The primary filters have now been completed, as well as the major part of the laying of new conduits and mains to incorporate the new works into the existing station.



DAM OF LOCHALSH, NORTH OF SCOTLAND HYDRO-ELECTRIC SCHEME

Hydro-Electric Stations

The numerous schemes of the North of Scotland Hydro-Electric Board are, of course, collectively the most important hydro-electric projects which were under construction in Great Britain during 1947, and some reference to them is made below. An industrial improvement scheme of some interest at the Ambergate Works of Richard Johnson and Nephew, Ltd., under construction in 1947, is also of interest. At these works water-power has been in use since 1763, when a tunnel and tailrace 1½ miles long was constructed parallel to the River Derwent downstream of a fixed weir some 12ft in height. Originally power was developed by water wheels, but more recently they were replaced by vertical spindle turbines. The scheme in progress in 1947 concerned prevention of flooding of the works built alongside the river upstream of the fixed weir. During extreme floods the river can rise as much as 8ft over the crest of this weir. To overcome this trouble, and at the same time regulate the head of water for the turbines, an automatically electrically operated flood control weir, consisting of three tilting gates 25ft long and 8ft high, was installed downstream of the old fixed weir, which is now to be removed. The gates are float-operated and maintain an approximately constant head except during extreme floods, when they open fully by lying flat on the river bed. Under these conditions the maximum flood height is reduced by 4ft in comparison with the original lay-out. This work was designed and supervised by Messrs. Husband and Co., of Sheffield, as consulting civil and mechanical engineers.

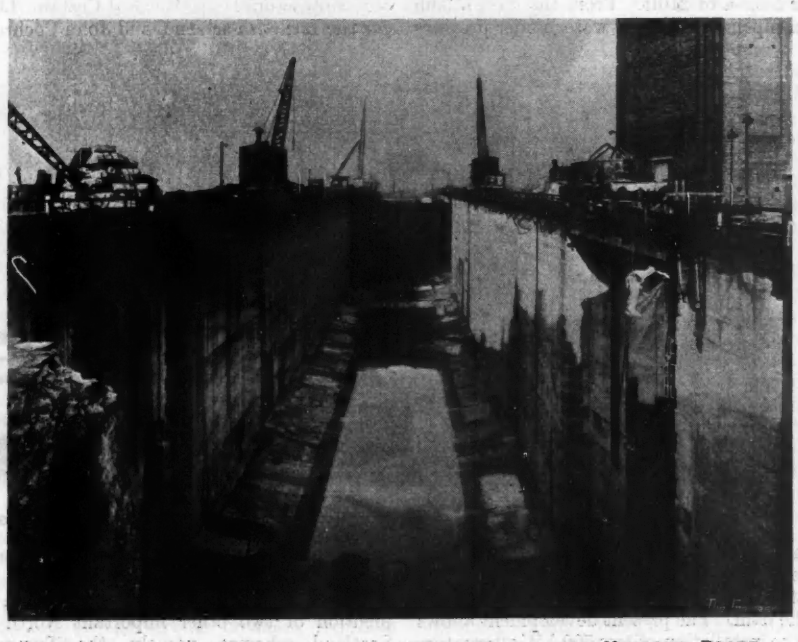
North of Scotland Hydro-Electric Board

More than 100 separate schemes are scheduled for construction by the North of Scotland Hydro-Electric Board, which operates under an Act of 1943, and it is possible to record that during 1947 good progress was made on several of these projects, where the preparatory stages had been passed.

Scarcely any part of Scotland is more than 50 miles from the sea. In spite of high rainfall in some districts the rivers are not of the size associated with large-scale Continental and American hydro-electric works. The Scottish projects may, therefore, appear small, but they have an interest of their own because of the diversity of problems which each separate scheme presents. The rivers are mostly "flashy," and large reservoirs are necessary, for which sites are not easy to find, owing to the extent of the glacial moraine pervious to water.

Extensive use of collecting aqueducts and tunnels from other catchment areas above the level of the reservoir permits a greater output of electric power than would otherwise be possible. A development scheme prepared by the Board in 1944, estimated that the Highland district is capable of producing an annual output of about 6,300,000kWh, in addition to 1,500,000kWh already developed. This additional power greatly exceeds all Scotland's present demands. By extension of the principal of trapping and diverting water from one watershed to another, the potential output can be increased substantially beyond the 1944 estimate.

The Board's Constructional Scheme No. 1 provides for a major project at Loch Sloy, in Dumbartonshire and linked with it a number of smaller schemes, such as are almost completed at Morar in Inverness-shire and at Lochalsh in wester Ross. At Loch Sloy there is under construction a dam 160ft high and 1150ft wide, tunnels and aqueducts from other parts of a 32 square mile catchment area, and a tunnel 16ft in diameter and 1¾ miles long through Ben Vorlich to the entry of high pressure pipe lines for the remaining gross head of 910ft to a power station to be built on the shore of Loch Lomond. Foundations for the dam and the erection of cableways for concrete placing were well advanced by the end of the year, as was the tunnelling work. A large quarry and conveyor system was



CENTRAL RIVER ENTRANCE LOCK OF MERSEY DOCKS AND HARBOUR BOARD

also practically ready for service. Messrs. James Williamson and Partners, of Glasgow, are the consulting engineers.

Civil engineering work on the Morar scheme was almost completed during the year. In this small scheme, operating under a head of 16ft, the power station is almost entirely underground, thus avoiding an unsightly structure at this beauty spot. A fish-ladder forms part of this scheme. Messrs. J. A. Leslie and Reid, of Edinburgh, are the consulting engineers.

An accompanying engraving illustrates progress last October on the Lochalsh scheme and shows the dam, of the mass concrete gravity type, across the Allt Gleann Udalein, of a maximum height of 42ft and a spill-weir length of 210ft. From the dam a 33in steel pipeline will carry water under pressure along the left bank of the river down to a generating station to be built adjacent to Nostie bridge, some 475ft below the crest of the dam. The present development allows for the installation of two 500-kW alternators driven by Pelton wheels.

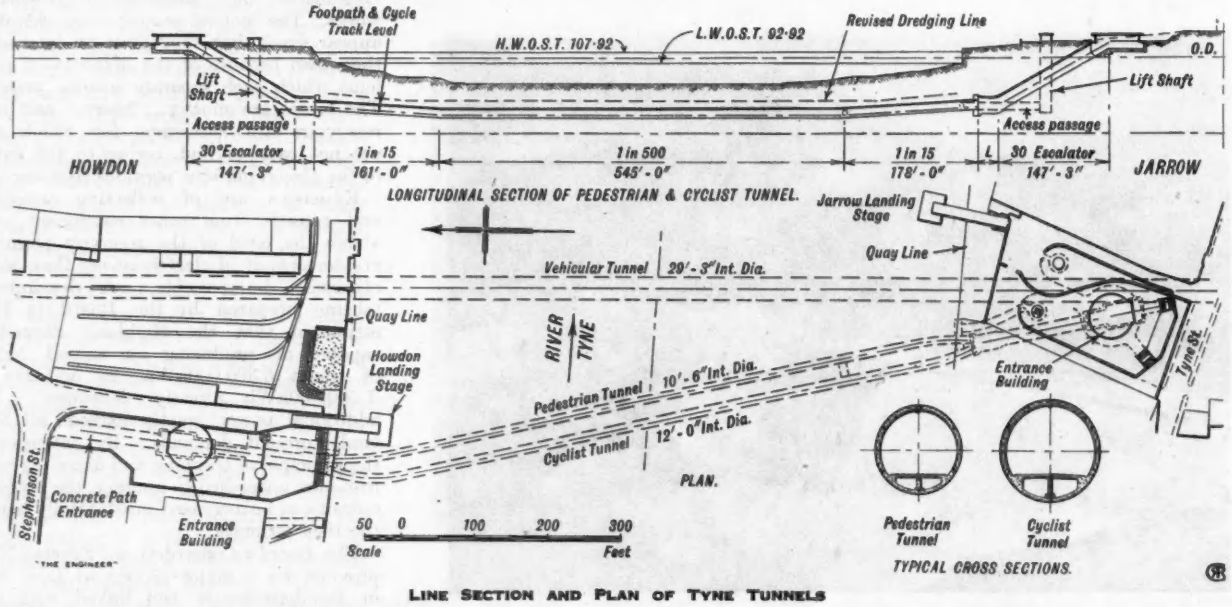
Work on the Mullardoch-Fasnakyle-Affric project started some six months ago. By impounding the waters flowing into Loch Mullardoch and Loch Benevean, on the borders of the counties of Inverness and Ross and Cromarty, a catchment of 124 square miles will be used. Progress at present on this big scheme is not far beyond the construction of workmen's camps and access roads. There will soon be started the building of a mass concrete gravity dam ½ mile long and 137ft high at the outlet of Loch Mullardoch and a 15ft 9in equivalent diameter partially lined tunnel 3¼ miles long to divert the waters of this valley into Loch Benevean. Another dam of the same type, 560ft long and 95ft high, is to be built across the River Affric, thereby raising the level of Loch Benevean by a maximum of 20ft. A power tunnel of 14ft 6in equivalent diameter is to carry water to three Francis turbines driving 22,000-kW alternators at Fasnakyle, some 500ft below the crest of the Benevean dam.

The engineers for the above two schemes are Sir William Halcrow and Partners, the contractors being Richard Costain, Ltd., for the Lochalsh scheme, and John Cochrane and Sons, Ltd., for the Mullardoch-Fasnakyle-Affric project.

Space limitations forbid more than a mention of two other important North of Scotland schemes, namely, the Tummel-Garry and Fannich projects. We must turn to other civil engineering works.

Mersey Docks and Harbour Board

Work in hand by the Mersey Docks and Harbour Board is the minimum required to offset in some small measure the damage sustained by the port during the war. In the case of the Central River entrance lock, work had been in progress in 1937, but during the war operations were suspended. This lock will considerably improve entrance to Princes Half-Tide dock and adjacent docks. Work was started again in December, 1945, and is now almost completed. The lock, 450ft long, 65ft 6in wide, and 58ft 6in deep, from coping to cill, is provided with an intermediate pair of gates giving compartments of 135ft and 315ft for smaller vessels. Each of these fully suspended intermediate gates is actuated hydraulically. An accompanying engraving illustrates the completed part of the lock and shows the outer gate recesses and the intermediate gates in position. It is hoped to give in another article a description at greater length of this interesting work of the Mersey Docks and Harbour Board, and also of other works, such as the repairs to Gladstone-Hornby lock, and the reconstruction of various transit sheds. Another interesting aspect of the Board's activities is the large scheme of training and dredging to improve the sea channels of the River Mersey, upon which work was continued during 1947.



LINE SECTION AND PLAN OF TYNE TUNNELS

ARCHITECTS DRAWING OF SEVERN BRIDGE

Tyne Tunnel

In June last the construction of the Tyne Tunnel, to link Jarrow and Wallsend by road, was begun. The project, as shown in the accompanying drawings, provides for three separate tunnels under the Tyne, for vehicles, cyclists and pedestrians, and for approach roads linking the tunnels with the

main traffic routes on each side of the river. The work which was in progress was on the construction of the two smaller tunnels for pedestrian and cyclists, the driving of the main road tunnel being left for some future date. A novel provision is the installation of twin escalators at the approaches to each of the smaller tunnels. Consulting engineers for the work are Messrs Mott, Hay and Anderson.

Severn Bridge Scheme

Much disappointment was felt when late in the year the Government announced that one of the works which would have to be postponed because of the economic situation was the proposed Severn Bridge, to the construction of which formal approval had been given only a few months before, on August 1st. In an accompanying engraving we reproduce the architects' drawing of the proposed bridge. The Severn road bridge, when built, will be the largest suspension bridge in Europe, with a central span of 3300ft and two side spans each of 1000ft. Vertical clearance for shipping will be 110ft above high water near the towers and about 120ft in the centre. Concrete anchorages to take the pull of the main cables will each be about 250ft long and 130ft wide, whilst the towers will rise to a height of 480ft above high water.

A bridge will also be built over the Wye to carry the new road, and the works will include the construction of about 8 miles of new roadways. The total cost of the scheme has been estimated at £9,000,000. Certain preparatory work was completed during the year and it was intended to begin construction on the piers within the next few months.

The consulting engineers are Messrs. Mott, Hay and Anderson, associated with Messrs. Freeman, Fox and Partners.

Port Talbot

In connection with the construction of new strip mills at Margam, Port Talbot, the Great Western Railway Company began improvement schemes on the transport facilities which will cost over £600,000. Railway engineering work will involve the diversion and doubling of nearly 1½ miles of track, the provision of two new marshalling yards with subsidiary lines and sidings, totalling 24 miles of track, the construction of six large and two small bridges, the laying of hundreds of yards of drainage pipes in the marsh land covering the site, and the extension of the existing brick and masonry culverts. The new bridges will have spans varying between 108ft skew span and 29ft square span. There will also be built two viaducts, totalling 17 spans, and 500 yards of retaining walls. This work, which is expected to be completed in two years, will at the peak, occupy more than 300 men, and it will entail the use of 800 tons of steel, 2,000,000 bricks, and over 1000 steel piles.

A great deal of preliminary work has also been carried out in connection with the lengthening of the main discharging quay of the G.W.R. at Port Talbot, to cope with the increased traffic the new works will bring to the port.

The existing wharf, which was constructed in 1924, is 878ft long. It is of reinforced concrete construction and is supported on over 400 reinforced concrete piles, some of which penetrate to a depth of 50ft below the existing ground level. A 36ft 9in depth of water is provided.

The concrete decking accommodates a footpath, three lines of railway tracks and a bogie rail track carrying the legs of two overhead transporter cranes used for unloading the ore from the ships to the ore-stacking yard behind the wharf.

The new extension being built to the north end of the wharf, together with additional dredging and some 215ft of sheet piling, will provide additional unloading facilities. The ore yard is to be extended and another transporter crane will be erected. For the new extension reinforced concrete will be used for the superstructure and piles as before. About forty-five additional piles will be driven, and it is estimated that the whole job will take about nine months to complete.

Five hydraulic pumps are to be provided for supplying power to the quayside and impounding pumps, with a capacity of 66,000 gallons per minute, for maintaining the water level of the dock.

(To be continued)

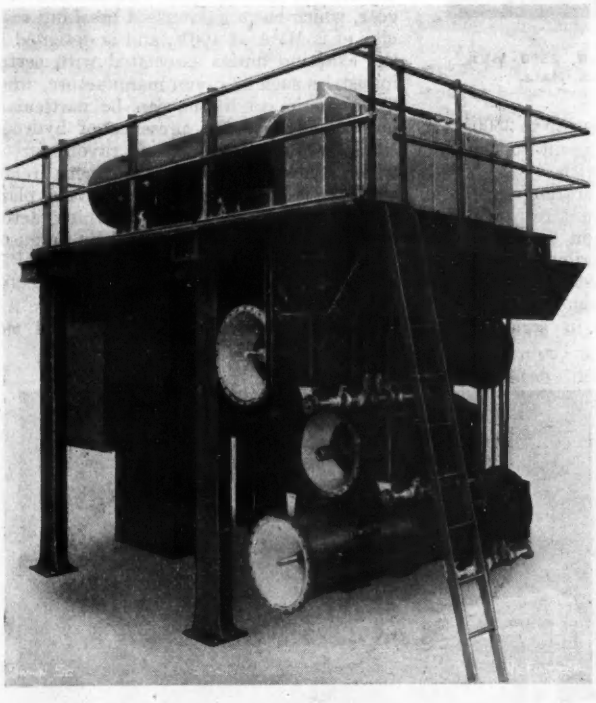
Electrical Engineering in 1947

No. III—*(Continued from page 35, January 9th)*

Switchgear

In the highly competitive field of switchgear, trends that were already noticeable in 1946 continued to develop in 1947, so that advances were made in the design of the orthodox oil-circuit breaker, to match the technical progress achieved in air-blast switchgear.

Considering air-blast switchgear first, one of the more interesting developments was the introduction of totally enclosed air-pressure-immersed metalclad switchgear. Six units of this new design, with a rating of 1500MVA at 33kV are being built by the English Electric Company, Ltd., for Leicester Corporation. One of these units is illustrated in a photograph reproduced herewith. This class of switchgear incorporates vertical isolation of the circuit breakers, isolation being effected by pneumatically operated thrustors. Complete phase separation is provided and all parts of the metalclad units are air conditioned, the air inside each chamber being maintained at a pressure slightly in excess of atmospheric pressure.



AIR PRESSURE IMMERSED METALCLAD 1500 MVA SWITCHGEAR

This company received a number of orders during 1947 for large switchgear installations employing air-blast circuit breakers. One contract from the Central Electricity Board comprised fifteen 2500-MVA air-blast breakers for the 132-kV switching station at Beddington. Export orders for air-blast switchgear included a 12-circuit, 150-kV, 2500-MVA installation for Spain, a 7-circuit, 165-kV, 2500-MVA switching station for a hydro-electric scheme in Portugal, and eleven circuit breakers for Tasmania.

Up-to-date practice in outdoor air-blast switchgear is well represented in the 2500-MVA, 132-kV installation which was completed recently by A. Reyrolle and Co., Ltd., at Hams Hall "B" switching station, Birmingham. A general view of this installation is given in one of the accompanying engravings. This company has a number of orders on hand for similar switchgear as well as for indoor air-blast equipment at 66-kV and for 132-kV small oil-volume power station switchgear. An interesting new Reyrolle development is the 33-kV, 500-MVA outdoor circuit breaker using single break contacts housed in a frame-mounted tank.

As indicated above, advances made in the design of conventional oil-circuit breakers have substantially bettered their performance and maintained active interest in this class of switchgear. The chief contribution to this advance was made by improved methods of arc control, using shunt resistors to reduce the arc duration. These methods, after being used by the British Thomson-Houston Company, Ltd., for 110-kV dead tank oil-circuit breakers, were extended to a new range of 132-kV "Shuntarc" oil-circuit breakers incorporating the B.T.H. self-compensated arc control chamber with switched shunt resistors. The operating mechanism and linkage were designed to minimise the "opening time" of the circuit breaker and to ensure high acceleration by reducing frictional losses and the inertia of moving parts. Recent tests on a circuit breaker designed for 132-kV service indicate that a total break time not exceeding 3 cycles can be attained on any duty within a breaking capacity of 2500MVA. A pneumatic auto-reclosing mechanism developed for use with these equipments has been

successfully tested in conjunction with a 2500-MVA, 132-kV circuit breaker. We are informed that this company is now executing orders for more than sixty "Shuntarc" circuit breakers for both 110-kV and 132-kV service at ratings of 1500MVA and 2500MVA, and that equipments of this

AIR BLAST SWITCHGEAR, 2500-MVA, 132-KV AT HAMS HALL

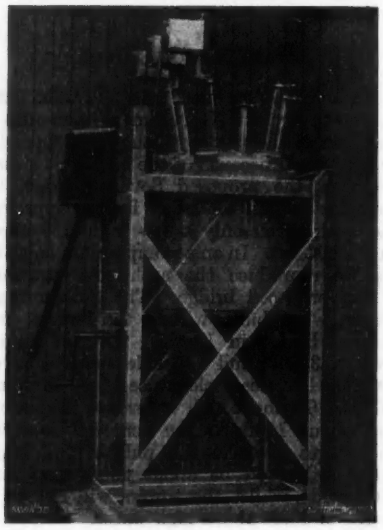
kind are available for ratings up to 3500MVA at 132kV. A typical "Shuntarc" circuit breaker is illustrated herewith.

Besides reducing arc duration and total break time, the use of shunt resistors connected across the explosion pots helps to ensure equal voltage distribution between the pots, so that for constant arc current the breaking capacity becomes proportional to the number of pots in series. This device is embodied in the "XOPR.54" oil-circuit breaker manufactured by Ferguson, Pailin, Ltd., with a rating of 2500MVA, 132kV, in accordance with B.S. 116–1937, and designed to have a total break time of not more than 4 cycles on a 50 cycles per second system, at all currents up to the maximum rated short-circuit value. To achieve such short operating times unusually high speeds are required and these are made possible by the use of torsion bar opening springs with low inertia instead of the usual helical accelerating springs. In addition, this circuit breaker makes use of electrostatic shielding to reduce the overall dimensions, so that the modern 2500-MVA oil-circuit breaker occupies less space than its original counterpart rated at 1500MVA.

In the field of high-speed low-oil content, metalclad switchgear, Ferguson Pailin introduced the "VLP-10" unit for a breaking capacity of 750MVA at 33kV, using the same general construction as the larger "VR-13/3" unit and embodying the same features, including the provision of tappings on all condenser bushings from which leads are taken to convenient points to allow power factor testing to be done in situ. The phases are completely segregated and, without sacrificing the advantages of double break or accessibility of contacts, the "VLP-10" unit is physically smaller than earlier designs with the same rating.

The same company reported an increased demand for its type "KC" industrial switchgear, which has a guaranteed breaking capacity of 25MVA at 400V, and is designed for the exacting duties associated with certain industries such as rayon manufacture, where atmospheric conditions can be particularly onerous, due to the presence of hydrogen sulphide fumes. A large rayon factory which is now being built in Northern Ireland will have its own 14,000-kW generating plant, feeding twelve substations, at which factory distribution will be controlled by Ferguson, Pailin "KC" switchgear. The initial installation will comprise seventy-three 600-A and 1000-A, "KC 4" and "KC 5" units. As a matter of interest, it is understood that the entire output of this large factory is intended for export.

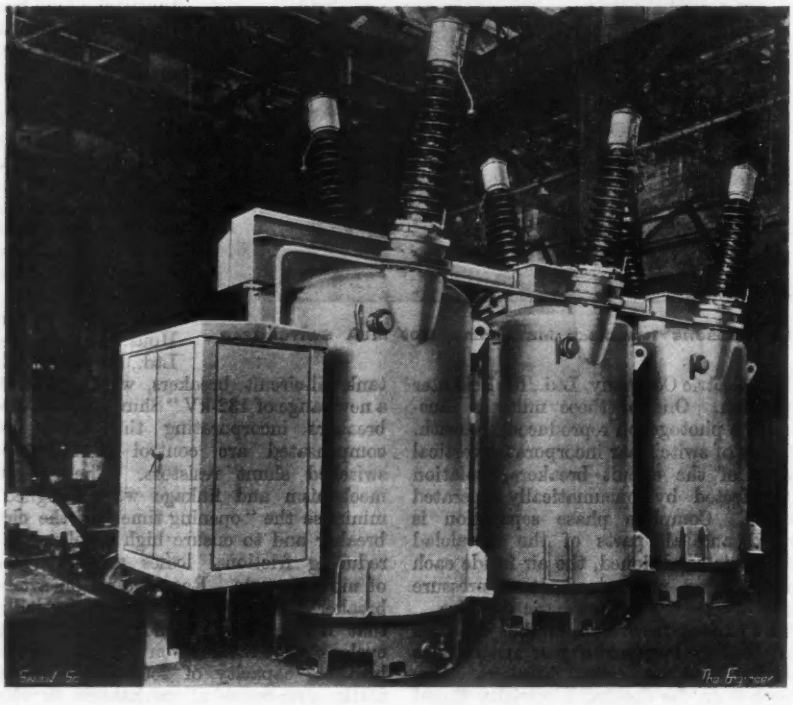
An interesting addition to the range of switchgear made by the Brush Electrical Engineering Company, Ltd., was a round tank cellular oil-circuit breaker designed for the particular needs of the export market.



CELLULAR OIL CIRCUIT BREAKER, 22-KV

This circuit breaker, an example of which is illustrated herewith, is similar to the kind of equipment that is widely used on the Continent. Designed for 22-kV service, with a rupturing capacity of 250MVA, this circuit breaker incorporates inverse time over-current series trips.

(To be continued)



"SHUNTARC" OIL CIRCUIT BREAKER, 2,500 MVA, 132-KV

Liege Bridge Rebuilding

IN 1940, all bridges crossing the River Meuse at Liège were blown up by the Belgian army engineers. During the war the river was crossed only by two temporary highway bridges. Rebuilding started in 1946, and now there are in the city one semi-permanent steel structure (Boveri Bridge) and two permanent concrete bridges (Coronmeuse Bridge and Pont des Arches). The Boveri Bridge is a lattice girder structure, 440ft long, with seven spans. The decking accommodates a roadway 23ft wide and two cantilevered footpaths. It was erected in five and a half months at a cost of 9,800,000 Belgian francs (£54,000). The Pont des Arches is a concrete structure 430ft long. It has three spans, the central span being 205ft long. The decking, 68ft wide, is carried on eight arch ribs, whose height varies from 2ft 6in to 18in, the width being 1ft 8in. The ribs are interconnected by means of transverse beams, with upper and lower slabs. In order to reduce construction delay, the contractors used steel centring, composed of Grey wide flange beams. The Coronmeuse Bridge was built for the Liège Exhibition of 1930, commemorating the centenary of Belgium. It is a concrete arched structure, 1030ft long and 58ft wide. The bridge arches were opened at the crown by means of hydraulic jacks, according to the method of the well-known French engineer, Monsieur Freyssinet, which was used for the concrete bridge over the Thames at Chiswick. On May 11, 1940, Belgian army engineers blew up the bridge, but reconstruction was carried out during the war. It was, however, damaged again by the retreating Germans in October, 1944. The Coronmeuse Bridge, entirely restored at a cost of 7·6 million Belgian francs (£43,000), is now again open to traffic.

Naval Construction in 1947

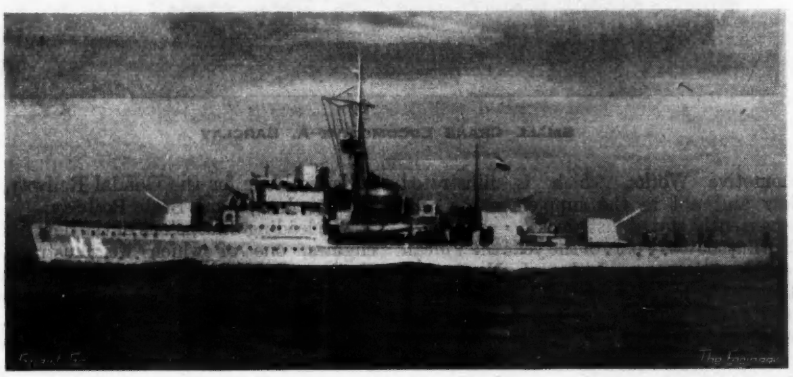
By FRANCIS McMURTRIE, A.I.N.A.

No. III—(*Continued from page 39, January 9th*)

ITALY'S position as a naval power is a somewhat curious one at the moment. Having been deprived under the Peace Treaty of more than half her remaining fleet, she is at the same time restrained from constructing or acquiring any more warships before January 1, 1950, except in replacement of accidental losses. Acquisition, employment, or even experimentation with battleships, aircraft carriers, submarines or motor torpedo boats are forbidden, and the total tonnage of the navy must not in any circumstances exceed 67,500 tons, excluding the old battleships "Doria" and "Duilio."

Yet, in spite of this, there would appear to have been additions to Italy's naval strength during the year that has passed. Presumably the above restrictions do not preclude ships being lent to Italy by the other signatories to the Treaty, for nearly fifty British and American minesweepers are operating with Italian personnel under the Italian flag. The largest of these are trawlers of Admiralty design, numbered "DR 301" to "DR 316." They comprise eleven of the "Isles" class, four of the "Dance" class, and one of the "Shakespearian" type. An equal number of motor minesweepers of the "MMS" series, numbered "DR 201–216," are in service, as well as a seventeenth unit, reported to be employed as a base degaussing ship. Sixteen of the American "YMS" type were at first numbered "DR 401–416," but have recently been given flower names, as have other vessels of the same class in the French navy. Nothing is known about the future of these ships, but it would seem possible that they may be permanently transferred to Italy after the end of 1949.

Apart from these acquisitions of uncertain duration, progress in rehabilitating the Italian fleet has naturally been slow. The



"VAN SPEIJK," NETHERLANDS

old destroyers of the "Carini" and "Abba" classes and the "Monzambano," have had their armaments reduced to one or two 4in guns and some small anti-aircraft weapons. The last-named ship and the "Carini" now mount only two torpedo tubes, while the "Abba" is without any.

Little alteration appears to have been made to the surviving twenty war built corvettes, though the "Ibis" was seen recently with a mast of lattice type and a somewhat more modern equipment than her sisters. The former seaplane carrier, "Giuseppe Miraglia," has been refitted as a repair ship and the twenty-year-old minelayer, "Azio," has been similarly transformed into a surveying vessel.

Apparently oil fuel is a little more plentiful with the Italian navy than in wartime, for during the months of July and August about twenty ships took part in a cruise which included various tactical exercises. This enterprise must have involved a certain amount of preliminary refitting of the vessels concerned.

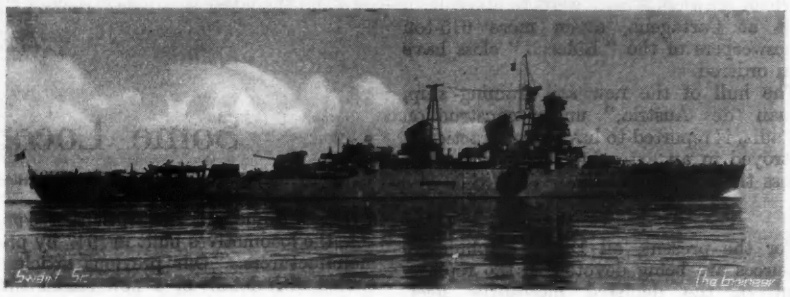
Soviet Navy

News from Russia continues to be scanty. Nothing further has been heard of the 35,000-ton battleship begun before the war, and though additional cruisers of the "Kirov" class are said to be nearing completion, it is suspected that the "Molotov," in the Black Sea, has only recently passed into service, though she was laid down as long ago as 1935, and was reputed to be nearly complete when the German advance obliged her to quit Nikolaiev in the summer of 1941.

The large Italian-built destroyer "Tashkent," which was sunk at Novorossisk during the war, is reported to have been salved and to be undergoing reconstruction. Six ex-Japanese destroyers, the "Haratsuki," "Hatsuzakura," "Hibiki," "Kaya," "Kiri," and "Shii," have been taken over in the Far East, together with seventeen escort craft, two minelayers, four minesweepers, and three transports.

Under the terms of the Peace Treaty with Finland, that country was to hand over to Russia the coast defence ship "Vainamoinen," of 3900 tons, together with five small submarines dating from 1930–33, and fourteen motor torpedo boats of three differing designs. So far as can be ascertained, only the first-mentioned ship has so far been delivered.

Apparently a large number of ships remain on loan to the Soviet navy, including the battleship "Arkhangelsk" (ex-H.M.S. "Royal Sovereign"), seven old American-built destroyers, and three submarines from the Royal Navy. Under the Lend-Lease Scheme, the United States navy, transferred to Russia thirty or forty minesweepers,



"TRE KRONOR," SWEDEN

twenty-eight frigates, some 200 motor torpedo boats, over seventy submarine chasers, about ninety landing craft, and a miscellaneous assortment of auxiliaries, such as icebreakers, tugs, &c. A proportion of this tonnage is believed to have been lost.

So far as is known, the principal naval construction in hand in Russian shipyards consists of submarines. German technicians in considerable numbers are said to be employed on this work.

Sweden

Both the new 7400-ton cruisers, the "Göta Lejon," and "Tre Kronor," have been delivered, together with the first of the 1800-ton destroyers, the "Oland," which is understood to have made her designed speed of 35 knots easily on trials. Her sister ship, the "Uppland," is expected to be ready in 1948, and two more of the class are to be ordered.

Ships discarded in 1947 included the old coast defence and depot ships, "Aran," "Tapperheten," "Dristigheten," "Jacob Bagge," and "Ornen," and the Italian-built destroyers, "Puke" and "Psilander," together with some small craft. Two new sail training ships, the 218-ton schooners "Falken" and "Gladan," have gone into service, replacing the "Jarramas," now nearly fifty years old. A new icebreaker is under construction.

Spain

Spain's largest warship, the cruiser "Canarias," of 10,670 tons, is to be taken in hand shortly for refit and modernisation. Laid down in 1928 and completed in 1936, she was designed to carry aircraft and a catapult, with both of which she has since dispensed. Her outstanding feature is the immense trunked funnel, serving two separate boiler-rooms. If the reconstruction of the older and smaller cruiser "Mendez Nunez," is any criterion, this conspicuous characteristic may be modified. In the latter ship three funnels have given place to two, entirely altering her appearance.

Progress with the twenty destroyers

under construction is slow, owing to difficulties in obtaining delivery of materials. Six of the 1010-ton "Audaz" class were laid down at Ferrol in 1945, but dates of starting work on the remaining three of this type and the nine ships of the "Oquendo" class, of 2050 tons, have not been advised. Nor is there any news of the "Alava" and "Liniers" (ordered to be built at Cartagena twelve years ago) having been launched. Work on these ships was suspended for some years, to allow the design to be modified.

Only four of the eight 1710-ton sloops of the "Cortes" class appear to have been completed. It was reported that negotiations were on foot for their sale to a Latin-American republic, but this does not so far seem to have materialised. In place of the fourteen trawlers which were to have been built at Cartagena, seven more 615-ton minesweepers of the "Bidasoa" class have been ordered.

The hull of the new sail training ship, "Juan de Austria," under construction at Cadiz, is reported to have been practically destroyed in an extensive fire which swept across the shipyard there.

Netherlands

For the present, all Dutch shipbuilding resources are being devoted to the replacement of the depleted mercantile fleet. In the meantime, little work appears to be under way on the hulls of the two cruisers, "De Ruyter" (ex-"Eendracht") and "Zeven Provincien," begun before the war by the Rotterdam Dry Dock Company, and the Wilton-Fijenoord yard, respectively. In fact, the "De Ruyter" has still to be launched; it is unlikely therefore that either will be ready before 1950.

Though the escort carrier "Karel Doorman" (otherwise H.M.S. "Nairana") is still on loan to the Royal Netherlands Navy, she is due to be returned on April 1st, when it is proposed to purchase H.M.S. "Venerable," a fleet carrier of the "Colossus" type, in her stead.

The cruiser "Tromp," of 4200 tons, is undergoing a prolonged refit at the Nederlandsche Scheepsbouw yard in Amsterdam. She may be altered in appearance when she comes back into service next summer. H.M.S. "Garland," a destroyer launched in 1935, has been sold to the Netherlands for use as a seagoing training ship. During the greater part of the war this ship was manned by the Polish Navy, earning a high reputation for hard fighting and efficiency in Malta convoy operations and other actions.

When war enveloped the Netherlands in May, 1940, there were under construction three coast defence gunboats of 1240 tons, provisionally known as K 1 to 3. Completed by the Germans, the first of these ships was lost in Norwegian waters, while the second was scuttled in port. Though salved by the Dutch, she was found to be too heavily damaged to be worth repairing, and has now been sold for scrap. The third unit, K 3, was recovered practically intact, and is now in service as the "Van Speijk." She is propelled by 4-stroke diesels of Klöckner-Humboldt-Deutz type, developing 1400 b.h.p., and giving a speed of 15·5 knots. The armament consists of four 4·7in, four 37mm, and six 20mm guns.

With the discarding of the small submarine "Dolfijn," Dutch strength in this arm is reduced to six vessels. It is hoped to supplement this by further acquisitions—possibly ships of the British "T" class, of which the Netherlands already possesses two.

Two old sloops, the "Flores" and "Soemba," have been relegated to subsidiary duties, the former as an accommodation ship and the latter as a radar training vessel.

A new repair ship, the "Vulkaan," previously H.M.S. "Beachy Head," has been taken over on loan from the British Government. She is a ship of the Canadian "Fort" design, with a standard displacement of 9173 tons and triple expansion engines of 2500 i.h.p.

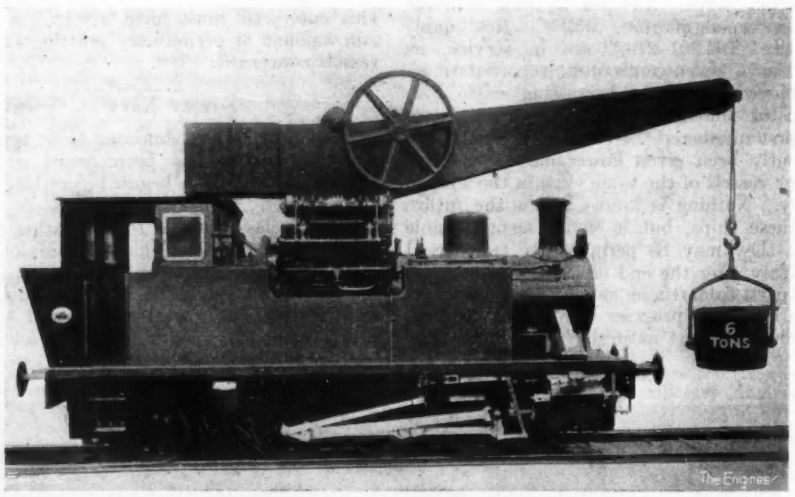
Other additions to the Dutch fleet include over forty motor minesweepers. Fifteen of these are of the British "MMS" type, ten of the American "YMS" class, and the remainder are ex-German räumboote. Former Japanese vessels appropriated include the surveying vessel "Luymes" (ex-"Gyosei Maru") and the salvage vessel "Triton," previous identity uncertain. It was sought also to acquire the ex-Italian sloop "Eritrea" and some smaller vessels from the same quarter, but there is no more news of this at present.

(To be continued)

Some Locomotives of 1947

No. II—*(Continued from page 51, January 9th)*

WE continue our description of some of the locomotives built in 1947 by private manufacturers. Our previous article concluded with details of a new steam turbine electric locomotive, built by the Baldwin Locomotive Works, which is illustrated below and not in the supplement as was inadvertently stated last week.



SMALL CRANE LOCOMOTIVE—A. BARCLAY

During the early part of the year the Vulcan Foundry Company, Ltd., of Newton-le-Willows, completed fifty "B.1" class 4–6–0 mixed traffic engines for the London and North Eastern Railway Company. Work is now in hand on a large number of "Y.B." 4–6–2 locomotives of the popular Indian metre gauge type. Fifty of these engines are intended for the Burma Railways, four for the Bhavnagar State Railways, of India, four for the Gondal Railway, and two for the Nizam's State Railway.

The leading dimensions of the new "Y.B." engines, one of which we illustrate, are similar to engines supplied to previous orders, although they have been considerably modified and brought up to date. In addition to improved cylinders and valve

6000 H.P. STEAM TURBINE ELECTRIC LOCOMOTIVE—BALDWIN

events, the engines are now fitted with a new pattern hind truck of the radial arm type. This truck replaces the radial axle-boxes with Cartazzi slides, which were fitted to the earlier locomotives. In the new truck the lateral movement is spring controlled and roller bearing axle-boxes are fitted. Designed for a maximum axle loading of 10 tons, the engines weigh just under 52 tons in full working order. With a working pressure of 180 lb per square inch, they have a tractive effort of 16,492 lb at 85 per cent boiler pressure.

Another order at present in hand at the Vulcan works is for a number of 4–6–2 "Y.C." type locomotives for use in Burma on the mail train service between Rangoon and Mandalay. These engines, which incorporate similar modernisations to the "Y.B." locomotives described above, weigh some 58 tons each and have a tractive effort of 19,729 lb at 85 per cent boiler pressure.

Among the number of industrial type locomotives built by Andrew Barclay, Sons and Co., Ltd., during 1947 was a special little 0–4–0 fireless engine for Bowater's Mersey Paper Mills, Ltd. It weighs 20 tons in working order and 16 tons empty. The locomotive was designed for a maximum steam pressure in the reservoir of 200 lb per square inch. A reducing valve fitted between the regulator valve in the reservoir and the cylinders reduces the pressure to 120 lb per square inch. When the steam pressure in the reservoir falls below 120 lb per square inch the steam is passed through the reducing valve to the cylinders without any reduction in pressure. The locomotive is arranged for charging from either side by means of quick coupling flanges and through a non-return valve fitted on left-hand side.

A small crane locomotive, which we illustrate, has been built by this company for Tata, Ltd., in India. It is designed to lift a maximum load of 6 tons at 18ft radius, and is capable of swinging this load in a complete circle.

The locomotive has cylinders 14½in diameter by 20in stroke, with piston valves actuated by Walschaerts valve gear. The boiler working pressure is 160 lb per square inch. The hoisting and slewing engines for the crane are fitted on the left and right hand sides of the locomotive, respectively, and are carried from the crane stool, which is a box structure built up from the locomotive frame and stands clear of the boiler.

The hoisting engines have cylinders 6½in diameter by 6in stroke, with trunk-guide slide bars. The valve motion is Stephenson's link type and steam is supplied to the engines at boiler pressure.

The slewing engines are the same size as the hoisting engines and all motion details are of similar size to reduce the number of spares required. The locomotive and crane weigh 52 tons in working order and 44½ tons light. The coupled wheelbase is 8ft and the total wheelbase is 13ft 6in.

Of fourteen locomotives completed during 1947, at the works of W. G. Bagnall, Ltd., many were of the industrial class for overseas purchasers. A typical 4–6–0 locomotive built by the company for gauges of 3ft 3⅜in and upwards had cylinders 15½in by 22in. With a working pressure of 160 lb per square inch the engine had a tractive effort of 13,213 lb at 75 per cent boiler pressure.

We reproduce a photograph of one of six 2–8–2 locomotives with eight-wheeled tenders designed and built by W. G. Bagnall, Ltd., for service on the Tanganyika Railway.

The new locomotives, which rank among the largest built for the metre gauge, weigh 98·2 tons in working order, complete with tender. They have been designed for a maximum axle load of 10 tons on the engine coupled wheels, and to negotiate minimum curves of 330ft radius and grades of 1 in 45.

It is contemplated that at some future date the gauge of the Tanganyika Railway may be increased from 1m to 3ft 6in, and with this end in view the locomotives were designed so that they could be converted with the minimum amount of modification. The wheel centres were designed so that new tyres can be fixed to the 3ft 6in gauge position by reducing the diameter of the wheel centre and increasing the tyre thickness ¼in. The brake gear was designed so that the alteration to the gauge would only mean transposing the brake hangers, no new parts being required.

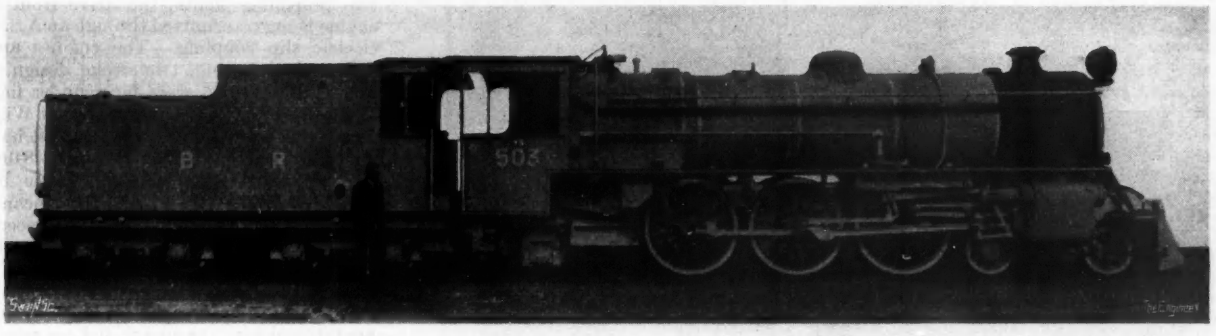
The boiler is large with a wide firebox, and a large grate area is provided for burning wood fuel or coal. A system of deflector plates and perforated plates fitted in the smokebox form a spark arrester.

The main frames are of the orthodox plate type, 1in thick at the front end, stayed by steel castings and widened at the hind end to accommodate the wide firebox. At the hind end the frame plate is ⅞in thick and is attached to the front frame plate by means of a robust joint casting of steel suitably ribbed to withstand buffing and draw stresses. A swing link central type front truck and the hind truck are both fitted with Timken roller bearings.

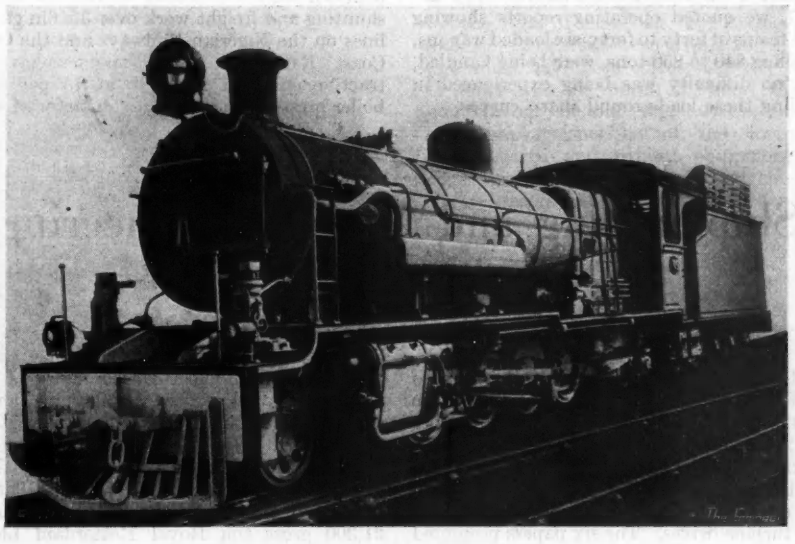
The following are the principal dimensions :—

Cylinders (2), diameter	17in
Piston stroke	23in
Wheels :	
Coupled, diameter	3ft 7in
Coupled, leading and trailing bogies, diameter	24ft ½in
Wheelbase :	
Rigid	12ft 0in
Engine, total	26ft 9in
Engine and tender, total	49ft 4½in
Length of engine and tender overall	60ft 11½in
Boiler heating surface :	
Tubes	1271·5 sq ft
Firebox	139 sq ft
Total	1410·5 sq ft
Superheater	320·5 sq ft
Working pressure	180 lb per sq in
Grate area	27 sq ft
Tractive effort at 85 per cent of boiler pressure	23,651 lb
Ratio of adhesion	3·7

Mechanical oil lubrication is provided for the coupled axle-boxes, The spring gear is compensated in three units, the front truck and leading coupled wheels, the two pairs of intermediate coupled wheels and the trailing coupled wheels and hind truck.



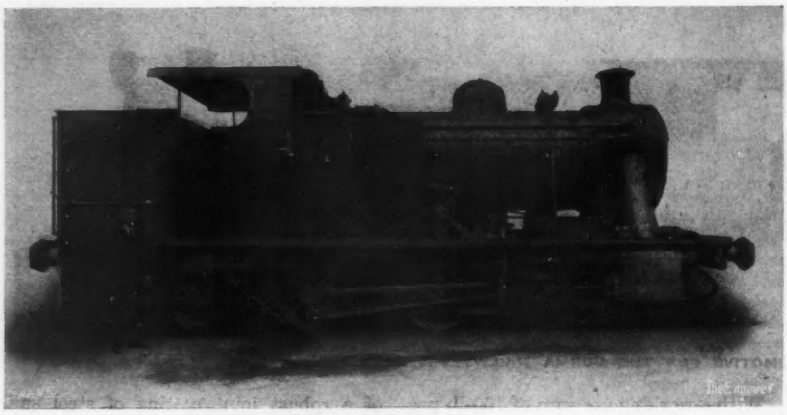
Y.B. LOCOMOTIVE FOR THE BURMA RAILWAYS—VULCAN



2-8-2 LOCOMOTIVE FOR TANGANYIKA—BAGNALL

The engine in working order weighs just under 57 tons, and the tender, which has a fuel capacity of 530 cubic feet and a water capacity of 4200 gallons, weighs 41·45 tons, a total for engine and tender together and in working order of 98·2 tons. The adhesive weight is 39 tons.

Among the industrial locomotives built at the works of the Hunslet Engine Company, Ltd., were six 0–6–2 tank engines for heavy shunting work at the Port of Calcutta. It was stipulated to the maker that these engines should each be capable of hauling a load of 1280 tons, made up of forty four-wheeled wagons of 15ft wheelbase, round a curve of 300ft radius, on which seventeen wagons would be travelling at the same time. The locomotives alone had to be capable of negotiating curves of 250ft radius without gauge widening.



0-6-2 SHUNTING ENGINE—HUNSLET

The engines carry sufficient fuel and water for twelve hours' continuous working and in full working order each weighs 65 tons. For simplicity in construction and ease in general maintenance, the engines have been designed to work on saturated steam at 210 lb per square inch. Although the pressure is limited to 210 lb per square inch in service, the boiler design calculations were based on 220 lb per square inch. With a tractive effort of 21,000 lb, at 75 per cent boiler pressure, the factor of adhesion is 5·25, against the adhesion weight of 49·2 tons.

In a description of these locomotives published in THE ENGINEER for May 23, 1947, we quoted operating reports showing that trains of forty to forty-six loaded wagons, totalling 840 to 850 tons, were being handled, and no difficulty was being experienced in hauling these loads round sharp curves.

Another engine built by the Hunslet Engine Company, Ltd., was a powerful 2–8–0 oil-burning freight locomotive for the Trujillo Railway of the Peruvian Corporation. Working on a 3ft gauge, the engine is designed to haul trains of 400 tons over ruling grades of 1 in 50, and traverse curves of 328ft radius. With the axle loading kept within a specified maximum of 12 tons, the adhesive weight is 48 tons, or 91½ per cent of the locomotive weight. It has a tractive effort of 25,200 lb at 75 per cent boiler pressure.

The boiler, which has a working pressure of 180 lb per square inch, has a barrel just over 5ft internal diameter and 12ft 4in long. A fire pan lined with firebrick below a shallow, round-topped firebox, houses the oil burner at its front end. This burner is carried on an accessible quick-release mounting which facilitates cleaning.

The engine has bar frames 4in thick made from steel slabs connected by cast steel and steel plate drag boxes and stretchers. Each cylinder, with a bore of 18½in and a stroke of 24in, is cast integrally with half of the smokebox saddle. The 9in diameter piston valves are actuated by Walschaerts gear, giving a maximum travel of 4 15/16in and a maximum cut-off of 80 per cent. The steam lap is 1in and the lead ⅛in. From the piston-rods drive is taken through Laird cross-heads on to the third pair of coupled wheels through connecting-rods 8ft 2in long.

Other orders completed by the company included some 0–8–0 tank engines for heavy shunting and freight work over 3ft 6in gauge lines on the Nigerian Railways and the Gold Coast Railways. These engines have a tractive effort of 23,500 lb at 75 per cent boiler pressure and an adhesion factor of 4·6.

Shipbuilding and Marine Engineering in 1947

No. III—(*Continued from page 47, January 9th*)

THE symposium on "The Engining of Cargo Vessels of High Power," arranged by the Institute of Marine Engineers in November last, proved of considerable interest to marine engineers in reviewing the claims of the geared turbine, direct and geared oil engines, turbo-electric, oil-electric, and gas turbine drives. The six papers presented were mentioned in our issue of November 21st, when we published a summary of the papers prepared by Dr. Stanley F. Dorey, chief engineer surveyor of Lloyd's Register of Shipping.

In the choice of prime mover more than usual interest attached to the installation of geared diesel engines in the 21-knot, 21,300 gross ton Royal Rotterdam Lloyd liner, "Willem Ruys," an illustration of which appeared in the first part of this article.

"WILLEM RUYS" GEARED OIL ENGINES

Although the design dates back to 1939, when she was laid down at the Flushing yard of the Royal De Schelde Shipbuilding Company, the installation shown in the accompanying plan is of technical interest, as it is different from that of any other large passenger liner. It consists of eight sets of engines in two engine-rooms, geared to the two propelling shafts, the drive from each engine being transmitted through an A.S.E.A. electric slip coupling. The engines are of Sulzer single-acting, two-stroke design, and four of these units were built under licence at Flushing and the remaining two at Winterthur. They are eight-cylinder units, having a bore of 680mm and a stroke of 840mm, the designed output of each engine being 3375 b.h.p. at 215 r.p.m. By means of reduction gearing, the engine speed is reduced to 120 r.p.m. at the propeller shaft. The maximum rating of the installation is 30,000 s.h.p. and the normal power about 27,000 s.h.p. The electric slip couplings are integral with the engine and are arranged next to the scavenging pump at the end of each engine. The whole of the gearing and casing is housed in the after engine-room. The control desk is in a central position at the aft end of this room, and we reproduce a view of this control panel in the accompanying engraving.

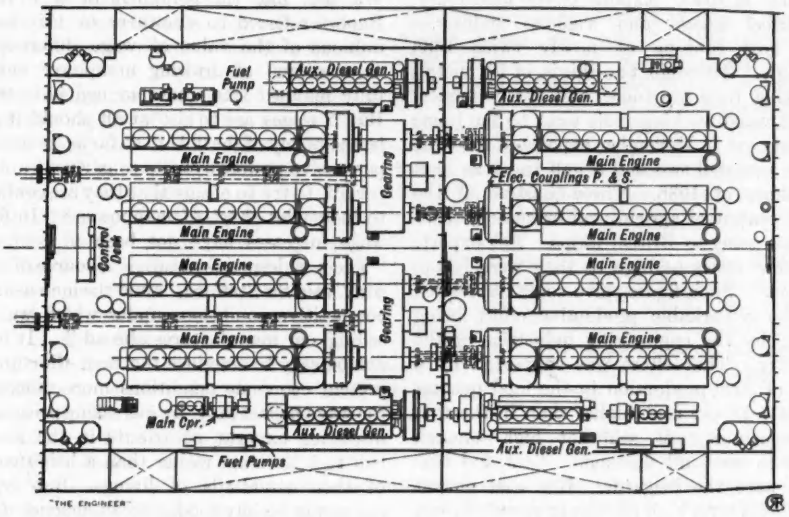
There are two sets of engine-room telegraphs, one for the port group of four engines and the other for the starboard group.

In accordance with recent Sulzer standard practice, all engine movements whether ahead or astern, are combined with and directly controlled by telegraph orders. For each group of engines there is also a lever for starting and a lever for the control of engine speed. It will be appreciated that as soon as one engine is started on air this unit, through the gearing, starts up the other three engines. A switch for cutting out or cutting in the couplings for each group is provided and by means of four levers any engine can be cut out or in as needed. The arrangement provides for the use of 32 cylinders at full power, or any number of engines needed for a particular cruising speed. During the technical trials, which we were privileged to attend, the machinery was tested under all loads, and at full load a trial speed of over 24·5 knots was recorded.

The arrangement of the auxiliary machinery is noteworthy. In the after engine-room are two Stork two-stroke, eight-cylinder, 1000-kW generating sets in the wings of the engine-room. In the forward engine-room there is an eight-cylinder Stork 1000-kW generator set and a 500-kW set driven by a six-cylinder Stork engine of the four-stroke type. The exhaust gases, before passing to the atmosphere give up their heat in exhaust gas boilers arranged in the funnels and the noise is reduced by silencers. The steam raised in the boilers is used to drive another power unit, a Stork 650-kW steam turbine generator set, and the exhaust from that unit is used in the distilling plant. This latter plant has a designed output of 150 tons per day, which is necessary in tropical conditions. An additional supply of steam is furnished by a Yarrow type three-drum water-tube oil-fired boiler in the engine-room.

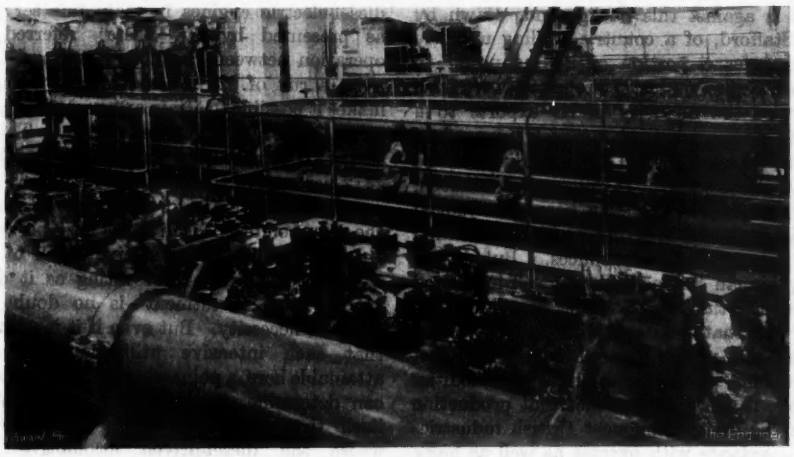
In the same engine-room forward of the two shown in the drawing, there is the Demag air compressor for the Siemens-Schuckert (Berlin) electrically controlled air supply for the anti-rolling tanks. In

MACHINERY OF THE "WILLEM RUYS"



GENERAL ARRANGEMENT OF ENGINE ROOM

CONTROL DESK



TOP PLATFORMS OF ENGINES

addition to the main anti-rolling tanks, in which the water is moved by air pressure, some of the fuel oil tanks below the engines are specially formed to act as natural anti-rolling tanks. A feature of the ship is the large amount of machinery supplied by British firms, either direct or in collaboration with their Dutch agents. Thus, Laurence Scott and Electromotors Ltd., supplied well over 100 electric motors for the Brown steering gear, the Carrier air conditioning plant for the engine-room pumps and workshops and for the Adams hydraulic sewage disposal plants. In combination with the Kennemer Machinfabriek, the Winsor Engineering Company of Glasgow designed and supplied pleno-units and supply and exhaust fans; the Dutch firm being entrusted with the ducting and its installation. Most of these fan units are enclosed in fan rooms and run quite silently. The motors for these fans were supplied by Veritys, Ltd., Birmingham.

Marine engineers will await with interest the performance of this fine ship, which is now on her maiden voyage to the Far East.

Shipbuilding and Machinery Outputs

It is not possible in the small space available to give detailed figures for the production of each shipbuilding yard and engine works, but we propose to refer briefly to the outstanding events of the year in the principal shipbuilding areas.

In the Belfast area, Harland and Wolff, Ltd., by launching sixteen vessels totalling 185,509 gross tons during 1947 broke its record of thirty-three years ago and established a new output record for the British shipbuilding industry. The previous highest record for a single British shipyard in any one year was achieved by Harland and Wolff, Ltd., in 1914, when an aggregate tonnage of 182,789 gross tons was put into the water. In the 1947 record a total of 148,882 gross tons was launched at Belfast, and four ships, totalling 34,627 tons gross, were launched at the firm's Govan yard, on the Clyde. These ships included three passenger and cargo liners, a whale factory ship, seven cargo liners, two cross-channel ships for passengers and cargo and three oil-tankers and a large naval vessel. The output of main propelling machinery was also a record figure, 307,000 i.h.p. being completed, to which total Belfast contributed 260,900 i.h.p. In addition, the firm completed oil engine machinery for land and transport purposes at home and abroad and for auxiliary purposes totalling 49,000 i.h.p. In giving these figures the company points out that the outputs were determined by the flow of materials and fittings, and had more materials been available, the output would have been correspondingly larger. It must also be borne in mind that, as pointed out in our first article, a very substantial proportion of the company's labour force and capital equipment was concentrated during the year on ship and engine reconversion and repair contracts and miscellaneous engineering work, none of which is reflected in the figures given above.

(To be continued)

Motor Vehicle Production and Registration.—The statistical department of the Society of Motor Manufacturers and Traders reports that the average weekly output of British motor vehicles in November was nearly 6000 cars and 3500 commercial vehicles. The number of new car registrations in Great Britain in October was 9467, or 2000 below the number registered in September, and new commercial vehicle registrations totalled 13,199.

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JANUARY 16, 1948

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DEATH

ON January 11th, at Lincoln, GEORGE RUSTON SHARPLEY, J.P., M.I. Mech. E., Chairman of Ruston and Hornsby Ltd., aged seventy-six.

WAGES AND RATIONS

How narrowly conceived is the T.U.C. "Interim Report on the Economic Situation," issued on December 31st was clearly revealed at the Press conference that Sir Stafford Cripps held last week. Whereas Sir Stafford gave facts and figures about the economic situation of the country and drew certain logical inferences from them, it might be supposed when reading the T.U.C. document, were it not for some references at the end to the need for greater output, that this land was self-supporting, that we had no need to exchange our manufactures for food and raw materials from other lands and that wage levels, hours of work, food subsidies and the like, could have no influence upon our external trade. To judge by its Report the T.U.C. is simple-mindedly concerned only to keep prices stable whilst permitting wages to rise. Yet, in fact, as Sir Stafford showed, there is, of course, an intimate relation between wage levels in our exporting industries and our success or failure in expanding exports; and if exporting industries are to be adequately manned there is equally a relation between the wage levels in unsheltered exporting industries and the more sheltered trades concerned only with the home market. The whole wage structure of this country therefore must be influenced by the prices our products can command in oversea markets.

Sir Stafford, at his conference, brought the whole matter into perspective. He referred, indeed, to the encouraging rate at which output was rising during the last months of 1947. Exports of the machinery, electrical goods and vehicles industries are now running at nearly twice 1938 volume. Although two-thirds of all metal-working tools produced and three-quarters of all wood-working tools went to the home market yet in November exports of machine tools were still two and a half times as high as those of 1938. Three-quarters of the total output of agricultural machinery firms is now going to British farms. Yet exports are four times as high as they were before the war. Such figures give some impression of the remarkable productive effort being made by the engineering industries of the country. That effort was supported by a rate of steel production in the final quarter of 1947 18 per cent higher than in the first threequarters, yet still not high enough fully to meet all demands. Coal and textiles were the laggards. But coal output reached a level high enough to permit export to be begun, whilst textiles showed an appreciable gain in rate of output towards the end of 1947. Such figures are encouraging. But in relation to the need for greater output and greater exports Sir Stafford referred to them as "only the foothills of achievement." The current trickle of coal exports compares very unfavourably with the figure of 36,000,000 tons exported in 1938. Steel production, high though it is, is unlikely to meet all demands in the present year. Its shortage will limit the output of the engineering and shipbuilding industries. Dependence for increased exports will have to be placed, therefore, mainly on the coal and textile industries, both of which are undermanned and both of which have assured markets abroad. Thus, to quote Sir Stafford, "in 1948 our main manpower task is to persuade workpeople to change over to the industries where they are most needed." Nor is it going to be easy, even if textile and coal exports can be expanded, to raise the level of exports from 112 per cent by volume above that of 1938, ruling in November last, to 140 per cent by next summer. For the oversea seller's market for many of our manufactured products is breaking and the heightening of our export figures is no longer only a problem of production in greater quantity. The goods must henceforth be offered at a sufficiently attractive price.

It is against this background, drawn by Sir Stafford, of a country needing urgently to transfer a portion of its manpower to undermanned industries and endeavouring to raise the quantity of its exports to a world no longer so clamorously in need of them that the T.U.C. Report proves so very disquieting. It recognises, indeed, that the real wealth of a people, as judged by its standard of living, is to be measured by the amount it produces. But in its very human but nevertheless self-interested insistence that wages must be allowed to rise and that food subsidies must be maintained and profits controlled in the interest of holding prices for essential commodities stable, it overlooks the fact that production must be divided amongst British industries in accordance with oversea as well as home demand; and that the products are of no value if their prices are so high that they cannot be sold in exchange for other goods, such as food, which the country cannot produce for itself in sufficient quantity. We are, like the compilers of a P. E. P. Report referred to elsewhere in this issue, dubious of the value of wage differentials as a means of drawing manpower out of fully manned into undermanned industries. But if wages are to rise at all should it not be the policy of the T.U.C. so far as its limited persuasive powers over its constituent unions permit, to try to ensure that they are confined to industries short of manpower? In fact, wage increases have not been so confined. "Their widespread nature is a source of concern" said Sir Stafford, "amid the increasingly competitive conditions under which we are selling our manufactures abroad." It may not be easy to convince the men that under present economic conditions more money in the wage packet may, by increasing prices and hindering exports, contribute in the longer run to a lowering rather than a heightening of their standards of living. But, since our power to buy foods abroad depends upon our ability to sell our manufactured products oversea, it is nevertheless true that as Sir Stafford put it, "every unjustified increase in export costs tends to reduce the workers' rations."

LOCOMOTIVE DEVELOPMENTS

IN our issue of December 26th last we published a description of a particularly interesting locomotive recently completed by the L.M.S. Railway, notable as being the first of its type for main line working in this country. This new design, which for its source of power makes use of a diesel engine with electrical transmission, will in due course be coupled to another exactly like it, and then tried out in fast passenger service, running in competition with two steam locomotives specially built for the purpose. We briefly referred to the first of the latter in a journal note also in our issue of the 26th.

Abroad, the diesel locomotive has during the last twenty-five years made rapid progress. If we are to judge by the paper on railway motive power contributed by Mr. Kiefer to the "Proceedings" of the Institution of Mechanical Engineers in June last, it would seem that in America, at any rate, locomotives of this kind are generally employed on long through runs. In fact, the performance data relating to diesel-electric engines in main line services as presented by Mr. Kiefer referred to operation between Harmon, N.Y., and Chicago, a run of 929 miles, which apparently makes it possible to attain an average revenue mileage of 27,000 miles per month. This is stated to represent an availability equal to 74·2 per cent of the total annual hours. The corresponding figure for steam power under the same conditions is given as 69·0 per cent. Intensive utilisation of motive power of the type under notice—representing as it does a very high investment—is no doubt an absolute necessity. But even if it is granted that such intensive utilisation may be attainable here, a point which only experience can determine, the further factor presents itself that oil is the fuel. In America, where the diesel-driven locomotive has lately been much developed, oil is often more readily obtainable than coal, more

especially in the Western States, where the diesel-electric engine first came into prominence. But here, in the more normal times that lie ahead, coal should be more readily available than oil, whilst even to-day the Government has been forced to slow down its coal-to-oil conversion schemes owing to difficulties in maintaining the supply of oil. In theory the idea of using a diesel engine as the prime mover of a locomotive is very attractive, if only because of the high thermal efficiency of that engine. But while Mr. Kiefer makes the statement that "diesels are definitely established in the motive power field and possess certain important inherent advantages over modern steam," he adds that "much still remains to be done if they are to continue to meet successfully competition with other forms of motive power. First cost, weight per horsepower, number of units for a given power, and overall length must be reduced." With those observations we find ourselves heartily in agreement and, in fact, certain of them presented themselves rather forcibly to us when we examined the L.M.S. engine. The weight, for instance, of the two units would be 242 tons for 3200 h.p., compared with the steam locomotive weighing 163 tons for the same power. The comparison is admittedly not quite correct because the steam locomotive does not carry a sufficient supply of water for the same length of journey. It is, however, interesting. The length of the two diesel units at 122ft compares with 74ft for the "Pacific" type steam locomotive. It may present a problem, especially when running into a terminal station with a long train. On the other hand, it is possible that the length of the diesel units can be somewhat reduced if more are built intended to operate in pairs.

These two experimental diesel-electric locomotives will arouse a great deal of interest when they appear in regular service, especially when, coupled together, they take their place on the Western division of the former L.M.S. system, running against the new very fine "Pacific" type steam locomotives. Much time will have to pass, however, before any comparative figures can become available; and even when they do, so difficult is it really to compare performance figures, there will no doubt be room for much discussion of the results. But of one thing there can be no doubt whatever. The L.M.S. Railway and in particular Mr. H. G. Ivatt, Chief Mechanical Engineer, are jointly to be congratulated upon their initiative in inaugurating this interesting motive power development, just as ownership of the railways passes to the State.

Obituary

REGINALD KIRSHAW PIERSON

AERONAUTICAL engineers in many circles will have learned with deep regret of the death on January 10th, following a long illness, of Mr. Reginald Kirshaw Pierson, chief engineer of the aircraft section of Vickers-Armstrongs, Ltd., and a special director of the firm. Mr. Pierson, who was only fifty-six years of age, died at his home, Manor Cottage, Cranleigh. He was educated at Felstead School, Essex, and Erith Technical Institute, and in 1908 he became a pupil apprentice with Vickers, Ltd., at the firm's Erith works. When, in 1911, the aviation department was formed, Mr. Pierson joined it, and from the first showed a keen interest in the new work. In 1913, shortly before the first World War, he qualified as a pilot and was awarded the pilot's certificate No. 660 of the Fédération Aeronautique Internationale, British Empire. He had already gained his B.Sc. (Eng.) London degree, and was from the first attracted to the design side of aviation work. A year before the end of the 1914–1918 war he was appointed chief designer.

He was responsible for the design of the Vickers "Vimy" Rolls-Royce commercial twin-engined aeroplane, which, we may recall, made the first direct transatlantic flight in 1919, and there followed the first flight to Australia, and the first flight to South Africa in the "Vimy" type of machine.

Among other well-known Vickers aircraft designed by Mr. Pierson, who was well known as Rex through the aircraft industry, we can include the "Virginia" twin-engined bomber, and the "Victoria" troop carrier, with which the Royal Air Force successfully carried out the evacuation of the whole of the civil population of Kabul in 1929.

Other types of aircraft designed by Mr. Pierson were the "Vildebeest" torpedo bomber, and the "Vincent" general-purpose biplane, followed by the famous "Wellington" twin-engine bomber, which was in production in 1939 at the outbreak of the last war, and remained in production until the cessation of hostilities.

World record machines designed by Mr. Pierson include the Vickers "Vespa," which in 1932 gained the altitude record, and the "Wellesley" long-distance machine which won the long-distance record of 7162 miles non-stop in 1938.

During the last war a useful machine designed by Mr. Pierson was the air-sea rescue aircraft "Warwick," which was widely used by Coastal Command.

His main work was carried out in the design department of Vickers-Armstrongs at Weybridge, and in 1945 he was appointed chief engineer of the aircraft section of the firm. In addition to his own work, Mr. Pierson for many years worked in close co-operation with the design department of the Supermarine Works, at Southampton, giving that section of the works, which was taken over by Vickers in 1928, the benefit of his extensive experience and advice.

He was made an associate member of the Institution of Civil Engineers in 1917, and served on the Technical Committee of the Society of British Aircraft Constructors. In 1913 Mr. Pierson became an Associate Fellow of the Royal Aeronautical Society, and he was elected a Fellow in 1926. For some years he was a Member of Council, and he served on various sub-committees. He gave two papers to the Society, one in February, 1928, on "The Use of the Wind Channel for Performance Prediction," and one in January, 1945, on "Design Factors of Civil Aircraft Affecting the Operating Costs." His death at a comparatively early age will be deeply regretted by his colleagues in the firm he has served so well, and among many friends in the British aircraft industry.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

THE 1937 FACTORIES ACT

SIR,—With regard to the statutory requirements for the regular examination of dangerous items of plant, e.g., pressure vessels, lifts, cranes, and lifting tackle, &c., I would submit for your reader's consideration that an early revision of the 1937 Factories Act is highly desirable.

It would appear that whilst the actual examination and certification of the plant at specified intervals is obligatory, there is nothing in the Act to compel an occupier to employ an independent inspecting authority to perform these duties. Furthermore, according to the Act, the only qualification that an inspector need have is to be considered a "Competent Person," but by what authority he is deemed competent is not laid down.

In consequence, we have a situation where, providing a factory occupier regularly examines his plant and files a copy of the report in the factory register he is at liberty to nominate any individual as a "Competent Person," regardless of qualification or experience and usually the competency of such a person is not queried until an accident has occurred, which may or may not have resulted in loss of life or injury to personnel.

The majority of factory occupiers do, of course, fully appreciate the responsibilities involved and employ the services of insurance companies to carry out examinations of plant, who, having regard to their own liabilities where such plant is insured by them (although insurance is not obligatory), employ "Competent Persons" having very definite minimum qualifications and experience. In addition, when the insurance company considers that any item of equipment is unsafe, they immediately inform the District Factory Inspector, who has the authority to seal the item until it is repaired and again certified serviceable.

It will be readily appreciated in what an impossible situation a "Competent Person" employed by the occupier finds himself when requesting his employer to put out of commission an item of plant which may in turn shut down the factory or at least slow down production.

A wide experience in this field has convinced the writer that the industrial accident rate could be appreciably reduced by revising the Factories Act to :—

(*a*) Adequately define the necessary experience and qualifications for "Competent Persons."

(*b*) Compel occupiers to have all dangerous equipment examined by "Competent Persons" employed by an independent inspecting authority. (The ideal method would be to make all such "Competent Persons" employees of the Crown.)

G. STANSFIELD.

Huddersfield, January 5th.

COAL AND ELECTRICITY

SIR,—Having read your New Year editorial with even more than the usual interest, in the issue of January 2nd, I am wondering how you arrived at the statement on page 16 that "the average coal fire wastes far more than nine-tenths of the heat in coal . . ." I really think this quite common quotation originated from some early electrical engineer with the pardonable fault of excess of zeal.

Professor C. L. Fortescue, in his Presidential Address to the Institution of Electrical Engi-

neers on October 1, 1942, gives the efficiency of the open coal fire as from 20 per cent to 30 per cent, that of the closed anthracite stove up to 60 per cent, and of central heating even in small houses as up to 60 per cent. He said that the efficiency of domestic electric heating in terms of the coal used in the power station was about 25 per cent. The Professor, being an electrical engineer, would not be biased in favour of coal fires.

I suggest, therefore, that we ought rather to emphasise the manifold other advantages of electrical methods, with which fuel firing cannot compare. Your conclusions would be equally right in principle if based on this argument, and with particular force if district heating from power stations is included.

W. C. KENNETT.

Hackbridge, Surrey, January 10th.

ON GIVING

SIR,—In the leading article "On Giving," which appeared in your issue of December 26, 1947, you attribute the saying *timeo Danaos et dona ferentes* to a Roman General! But Virgil tells us (Aeneid ii) that the words were spoken by the ill-fated Laocoon, a priest of Troy, in a spirited but fruitless attempt to persuade his fellow citizens to have nothing to do with the wooden horse.

"PEDANT."

London, W.C.2, January 5th.

PEOPLE AT WORK

SIR,—The title of your leader in THE ENGINEER of December 26th was sufficiently arresting to make me pause and carefully follow the contents.

My immediate reaction was one of bewilderment that any body of people should find the question "What makes people like to work?" so profound as to warrant the holding of a conference. Perhaps it is that I, and many like me, having taken to work with little question, are now "wanting" in our appreciation of what we are doing, being inured to labour and knowing it not.

Was it not Adam who was told that "by the sweat of his brow would he till the earth"? Maybe this is the "work climate" the august Institute of Industrial Administration set out to discover, although, with the passage of years, the "sweat of the brow" has evaporated somewhat and, with it, the fear of famine. Do we not, however, pride ourselves on our advanced educational attainments and should not these, for the worker as well as for the administrator provide the power of reasoning to replace the goad of necessity?

I would recommend that any wishing to study "what makes people like to work," take a trip to Scotland, there to see the housewife transporting her washing from tenement to washhouse, where machinery, hot water, and all facilities exist for the performing of a task which could be done in the home but is more easily and better done by machinery.

The "work climate" here seems to be that of getting back home as early as possible and so, without the presence of doctor or nurse or welfare officer, or canteen attendant, she applies herself to the job and quits the workshop when her task is done.

What is the difference between the circumstances in which the Scotch tenement housewife finds herself with a week's washing to contemplate and those of us who go to the factory to do work we cannot for one reason or another do at home? Whether it be shirt-making, boot-making, suit-making, printing machinery-making—so that we can have our daily papers— marine engine-building—so that we can have the wherewithal brought to us—we all proceed to the workshop or office to do the things we cannot conveniently do at home. They must be done; the sooner they can be done the better, and, furthermore, it becomes evident if we can rid ourselves of the supernumaries and the personal embellishments in establishments and Government departments, more hands will be available to do the essential tasks.

Perhaps, however, it is intended the question of "work climate" be pursued with a view to finding some way of countering the argument that "Ah, well: this is all very good, but what about the profit?" For this I cannot see any "work climate" taking the place of understanding.

A. HOARE.

Carisbrooke, I.O.W., January 12th.

RAZOR BLADE LIFE

SIR,—In your issue of June 8, 1928, you attracted much interest by an article which described the working life of an average razor-blade. You might like to know that I am still using a well-known brand of safety razor-blade which has been in daily use since August 25th of this year. This blade has already mown a beard of average growth for 107 days. Its only assistance has been a daily polish, barely amounting to stropping, on a small piece of chamois leather, 2in by 1in.

Though unattractive to the vendors of razor-blades, such a stout performance should delight the heart, however pebbly, of the Minister for Economic Affairs, and might be of interest to metallurgists.

TONSOR.

Hook, Hants, December 9, 1947.

London Transport's Plans

PLANS for improvements this year in London Transport's road and rail services were outlined by Lord Latham, chairman of the London Transport Executive, at a Press conference on Monday last. He prefaced his statement by saying that despite difficulties over maintenance and renewal of vehicles, London Transport's buses, trams, coaches and trains ran an all-time record of approximately 610,000,000 miles in the public service in 1947.

With regard to road services in 1948, Lord Latham said that the intention was to put 1200 new buses on the road. This would be an instalment of the 4000 vehicles now on order and it was hoped that this year's deliveries would not be affected by Government curtailments in vehicle production. The buses arriving this year would go towards replacing those which, on account of the war, had far outlived their normal use. It was estimated that London needed more than 500 buses over and above the present fleet of 9000 road vehicles, and there was a three-stage bus plan for London. The first stage, Lord Latham explained, was to replace outworn buses, the second stage was to strengthen existing services known to be inadequate, and the third stage was concerned with the extension of existing routes and the opening up of new routes.

Lord Latham went on to say that it was hoped to introduce this year 500 buses with a width of 8ft, as compared with the 7ft 6in width of existing vehicles. For a start they would be in service on suburban routes until such time as an experiment with their use could be made in the West End. One big item of development, however, the conversion of the South London tramways, would have to wait possibly five years because of the slowing down of manufacture of new buses. Meanwhile, £1,000,000 had been expended on the tramways in 1947 to keep them in the highest state of efficiency pending replacement.

On the subject of railway plans, Lord Latham said that it was hoped to extend further the Central Line both in the east and in the west. From Woodford it would be carried north to Buckhurst Hill and Loughton, and from Newbury Park to Barkingside, Fairlop and Hainault. Between Hainault and Woodford, which constituted the north side of the Fairlop Loop, a shuttle service would run, serving Grange Hill, Chigwell and Roding Valley. The section from Newbury Park to Hainault would be open to passengers this summer, and if the other extensions were allowed to go ahead, services on them will begin it is hoped at the end of 1948 or early in 1949. Shortly before that in the west, the Central Line would be extended to Northolt, South Ruislip, Ruislip Gardens, and West Ruislip. Also late this year important works would be completed to give improvements on the Metropolitan Line. Track bottlenecks at Harrow-on-the-Hill and Preston Road were being abolished by relaying five miles of track. When this work was completed, it was intended to improve the service on the line by increasing the frequency of trains between Uxbridge and Baker Street from eight to twelve trains per hour.

PLANS TO CUT DELAYS

To reduce inconvenience to passengers when Underground delays occur, Lord Latham said that there would be completed this year an all-station broadcast information network, so that there could be broadcast simultaneously information of delays, sudden frost, special crowds, &c., direct from the Central Traffic Control. This information would enable station staffs to make the best possible traffic arrangements in the minimum time and keep the public better informed.

There was also to be set up this year a telephone system giving an instant link between tube trains in tunnels and the Central Control. The driver of any train which was delayed in a tunnel would be enabled to speak direct from any point in the tunnel to the Central Control.

Lord Latham also reported that to combat delays caused by snow and ice half London Transport's lines had already been equipped with special de-icing machines. This system was to be doubled in size in 1948 by installing de-icing machines on the remaining lines, the Northern Line and the Metropolitan and District Lines. The Northern Line will be fitted by February and the other lines before next winter.

With regard to rolling stock and equipment, Lord Latham said that there were on order 143 new Underground cars, the first of which were expected in July, while an additional escalator would be installed at Holborn and another at Chancery Lane during the present year. As soon after as possible, also, a fifth escalator will be installed at Liverpool Street. Track improvements would include the further installation of half-mile lengths of jointless rails.

Another matter of special interest mentioned by Lord Latham was that London Transport had recently been granted a licence to use short-wave wireless experimentally. A central station working on 77·2 megacycles was to be installed at Earls Court and would enable engineers to communicate with each other on the job and to pass demands for tools and materials instantly for emergency work and so on.

THE "POWER-RECORDER."—To eliminate guesswork in the measuring of engine usage and wear, the "Power-Recorder" has been developed recently by Square D Company's Kollsman Instrument Division, New York. By recording the cumulative power-hour units turned out by an engine, the instrument provides measurement of total engine wear and, it is claimed, promises to be of value to all commercial airlines as a practical means for determining the time for servicing of the engines and thus increasing operating efficiency and economy in maintenance. Two types of recorder have been developed, one with a flexible shaft connection to the engine tachometer outlet and another a remote operating type which is electrically driven by a tachometer generator mounted on the engine tachometer outlet. For uses other than aircraft, the device can be calibrated in any convenient units, such as horsepower-hours.

Prime Movers in 1947

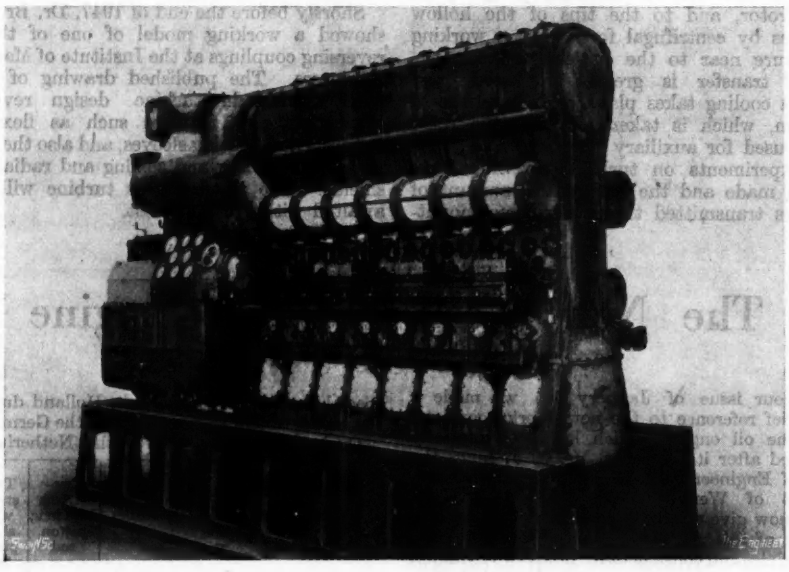
No. II—(*Continued from page 46, January 9th*)

SULZER BROTHERS, WINTERTHUR, SWITZERLAND

IN the month of August, 1947, Sulzer Brothers, of Winterthur, celebrated fifty years of construction of diesel engines, which was commemorated by a special issue of the Sulzer Technical Review, in English. It was reviewed in our issue of September 19th, when we illustrated the erection of the latest design of marine engine of 7300 b.h.p.

A new engine of 1947 was the supercharged, opposed piston oil-engine, built for the type of drive requiring a high concentration of power. It was seen on test in the Winterthur shops during one of our visits to Switzerland. As will be noted from the accompanying engraving, the engine has a welded casing and the supercharging unit comprises an axial air compressor and an exhaust gas turbine. In later designs it is possible, the makers state, that the axial compressor may be replaced by a radial compressor with some advantage. The principal dimensions of the new unit are as follows: designed output, 2500 b.h.p.; number of cylinders, eight; cylinder bore, 180mm; piston stroke, 225mm; normal running speed, 1000 r.p.m., and supercharging pressure, 2·5 atmospheres. The engine has the low weight of 8 lb per brake horsepower developed. The cylinder liners have double walls, forming a water jacket, but the cooling water is not in contact with the welded steel cylinder block at any point, so that the 4mm thick plate of which it is made cannot rust or corrode.

During the period under review, it was stated by Sulzer Brothers with regard to the development of free piston engines and their application to gas turbine drives, that investigations made up to the present seem to show that the advantages of free piston turbine plant as a whole, over the power range of merchant ships, are not sufficient to make this type of prime mover a serious competitor to the diesel engine or pure gas turbine installation. The firm decided therefore to give its prior attention to the development of the pure gas turbine with a combustion chamber. In this direction a marine gas turbine plant, of 7000 to 9000 h.p. is well under way at Winterthur, and will be subjected to extensive test-bed trials this year, before being installed in a ship. In March, 1947, an order was placed with Sulzer Brothers by the North East Power Company of Switzerland, for a 20,000-kW gas turbine plant, which will take up service in the Weinfelden power station for supplying supplementary winter energy at the end of 1949.



2500 B.H.P. OPPOSED PISTON SUPERCHARGED SULZER OIL ENGINE

Both these turbines will work on the new high pressure cycle developed by Sulzer Brothers, to which we made a short reference in our last year's review. The cycle shown in the accompanying diagram was designed to fulfil three basic requirements simultaneously, namely, high efficiency, small size and low weight. It permits of efficiencies well over 30 per cent over a wide range of loading.

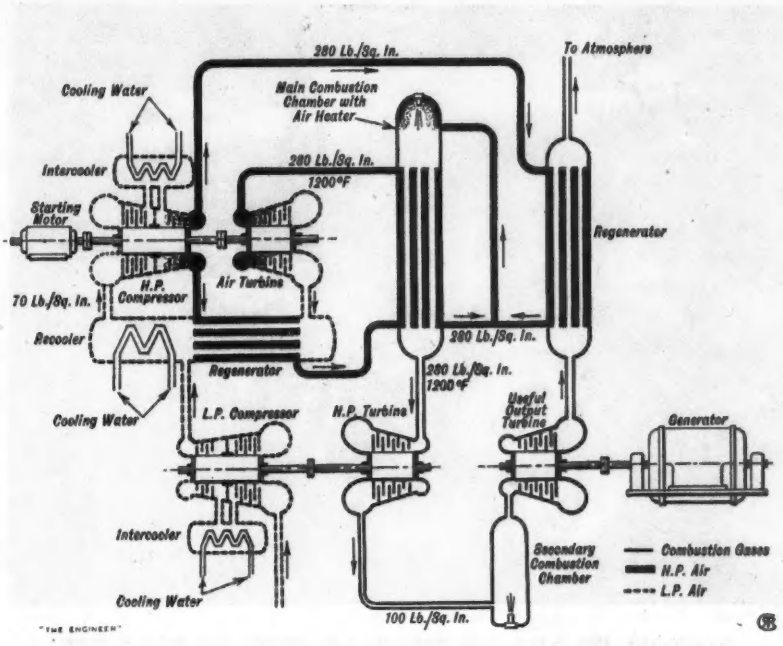
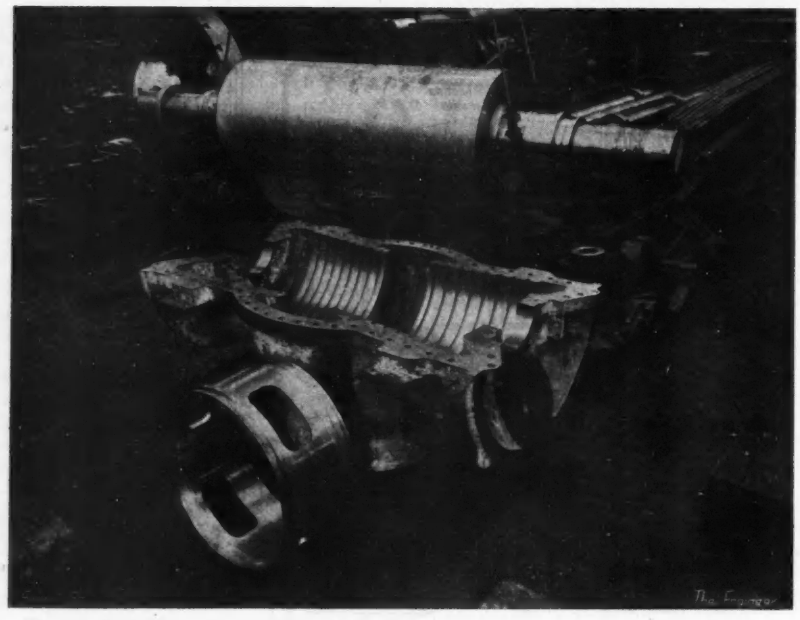


DIAGRAM OF SULZER HIGH PRESSURE CYCLE

One part of the plant consists of a circuit through which the working medium flows under pressure. The air used as the working medium is drawn in at a pressure of 70 lb per square inch by the high pressure compressor, which raises its pressure to 280 lb per square inch at a temperature of 1200 deg. Fah. Part of this air flows through the regenerator and the air heater in the main combustion chamber, in which it becomes heated to its maximum temperature. The expansion of the air to about 70 lb per square inch takes place in the air turbine, which drives the high pressure compressor. After leaving this turbine, the air passes through the regenerator and the recooler and returns to the high pressure compressor at a pressure of 70 lb. The fundamental difference of this cycle as compared with the closed-cycle turbine is in the fact that high pressure air is continuously extracted from the circuit just described and is used as combustion air. After flowing through the regenerator, where it is preheated by the waste gases, the air reaches the combustion chamber of the air heater. The hot gases which are produced by combustion are led through the tube nest of the air heater, and heat the air to the highest temperature admissible for the air turbine, while at the same time they are cooled down to this temperature. The combustion gases are expanded to about 100 lb per square inch, the high pressure turbine and are then reheated to their initial temperature in the secondary combustion chamber and finally expand to the atmosphere, after passing through the regenerator, in which they give up part of their heat to the compressed air. In order to replace the quantity of air extracted from the circuit, a low pressure air compressor is provided,

with the duty of drawing in air from the atmosphere and supplying it to the low pressure part of the circuit. The air is cooled in the recooler, together with the circuit air leaving the regenerator before passing to the high pressure compressor. The low pressure compressor is driven by the high pressure turbine, and the low pressure turbine provides the useful output and drives the generator unit. In the diagram given, a starting motor is provided on the high pressure compressor and air turbine shaft. Water connections to the intercoolers and recooler are also shown. The Sulzer air heater has an equality of pressure on both sides of its tubes; it is claimed that it is small in size and has an efficiency approaching 100 per cent. The cycle is suitable for high powers but is less suited to powers below 6000 h.p., as the manufacturing costs per horsepower installed are then relatively high.



PAMETRADA 3500 S.H.P. GAS TURBINE, L.P. ROTOR AND HALF CASING

THE NATIONAL GAS TURBINE ESTABLISHMENT

In September last we paid a visit to the National Gas Turbine Establishment at Whetstone, Leicestershire, where a group of exhibits were on view, not only from Whetstone, but also from Pyestock, near Farnborough, where work on aero dynamics, combustion, performance, and project assessment is carried on. The establishment is under the direction of Dr. H. Roxbee Cox. Wing-Commander G. Lees has charge of manufacturing and testing work at Whetstone, and Mr. H. Constant of the research work at Pyestock. The establishment exists for increasing knowledge of gas turbines for all purposes, whether on land, at sea, or in the air. It carries out fundamental research work on the basic problems of the flow of air, the combustion of both light and heavy fuels, the behaviour of materials under high temperature conditions, stresses in components operating under working conditions, and methods of manufacture. The establishment also undertakes the assessment of new designs and offers facilities for the testing of compressors, jet turbines, and engines, made by private firms. In the test house a 6000 h.p. special turbine, taking steam from a Thompson-Lamont water-tube boiler, and running at a maximum speed of 18,000 r.p.m., can be used for compressor, turbine, or jet engine testing. Many combustion experiments were illustrated which represented some of the research work carried out at Pyestock.

In one of the test houses experiments were being made with a German experimental gas turbine, having water-cooled blades and a water-cooled rotor. This unit was taken from the Augsburg works of the M.A.N. Company and was fully described in a recent Government publication.

Water enters the hollow centre of the rotor and is delivered to the inner periphery of the rotor, and to the tips of the hollow blades by centrifugal force. At a working pressure near to the critical pressure, the heat transfer is greatly increased, and rapid cooling takes place, with a release of steam, which is taken off from the rotor and used for auxiliary purposes.

Experiments on turbine vibration have been made and the nature and amount of forces transmitted through turbine mountings investigated. There is an engineering shop at Whetstone and a foundry. Precision casting by the "lost wax method" was used with success, and we saw Vitallum cast blades, with a high degree of finish. The mechanical and physical properties of blades have also been studied. Some engineering firms who are engaged in gas turbine design are already in contact with the National Gas Turbine Establishment concerning matters of mutual interest.

PAMETRADA RESEARCH STATION

In addition to the 500 h.p. gas turbine designed for John Brown and Co., Ltd., referred to in our first article, Pametrada, under the direction of Dr. T. W. F. Brown, gave special attention during the year under review to the design of a 3500 h.p. marine gas turbine, which will, as regards its design, fulfil all the requirements for manœuvring and speed control which we associate with a marine unit. Eleven member firms collaborated in the construction of this turbine, with a view to accelerating delivery. It was hoped to assemble this unit before the end of the year, but delay occurred. Many of the principal components are well advanced and we show herewith a view of the l.p. casing and rotor and part of a control valve. The speed of the main shaft is 85 r.p.m., and the turbine is unidirectional and works on the series flow open-cycle principle.

During the year Dr. Brown and his staff studied the whole question of power transmission. In their view a most hopeful method of reversing gas turbines appeared to be by the use of ahead and astern hydraulic couplings built into the reduction gearing. Couplings can be designed with a high efficiency characteristic and with relatively large clearances, and if one coupling be loaded against the other through the neutral point the output turbine can be stalled and has no tendency to run away. Again, it is pointed out that the characteristics of such couplings match the propeller load characteristics.

Shortly before the end of 1947, Dr. Brown showed a working model of one of these reversing couplings at the Institute of Marine Engineers. The published drawing of the 3500 Pametrada turbine design reveals interesting new features such as flexible supports and floating sleeves, and also the use of air for cooling and sealing and radiation shields. The tests of this turbine will be awaited with great interest.

(To be continued)

The New Werkspoor-Lugt Engine

No. I

IN our issue of January 9th we made a brief reference to the new Werkspoor-Lugt marine oil engine, which has been officially named after its inventor, Mr. G. J. Lugt, the Chief Engineer of the Diesel Engine Department of Werkspoor N.V. of Amsterdam. We now give a longer account of the development of this new prime mover, its underlying principles and construction. It is a two-cylinder, single-acting, two-stroke, supercharged engine, designed to develop 600 b.h.p. per cylinder, or 1200 b.h.p. total under normal running conditions. We have already mentioned its output of 950 b.h.p. when running without supercharging, and now propose to deal with the final supercharged design.

The main dimensions of the new two-stroke engine as compared with the Werkspoor standard four-stroke engine are given in the following table and one of our drawings.

Dimensions	Four-stroke	Two-stroke with long piston rod	Two-stroke with short piston rod
Output, b.h.p.	3600	3600	3600
Speed, r.p.m.	125	130	130
Number of cylinders	8	6	6
Cylinder bore, mm	650	600	600
Piston stroke, mm	1400	1100	1100
Mean effective pressure, kg per square centimetre ...	7	6·7	6·7
Total weight, metric tons ...	315	155	140
Weight per litre cylinder capacity in kilograms ...	85	83	75

The history of the development of this new engine is of an unusual nature owing to the special conditions obtaining in Holland during the occupation of that country by the Germans. During five years of war the Netherlands was entirely cut off from the rest of the world. What was happening in the sphere of large oil engine construction in other parts of the

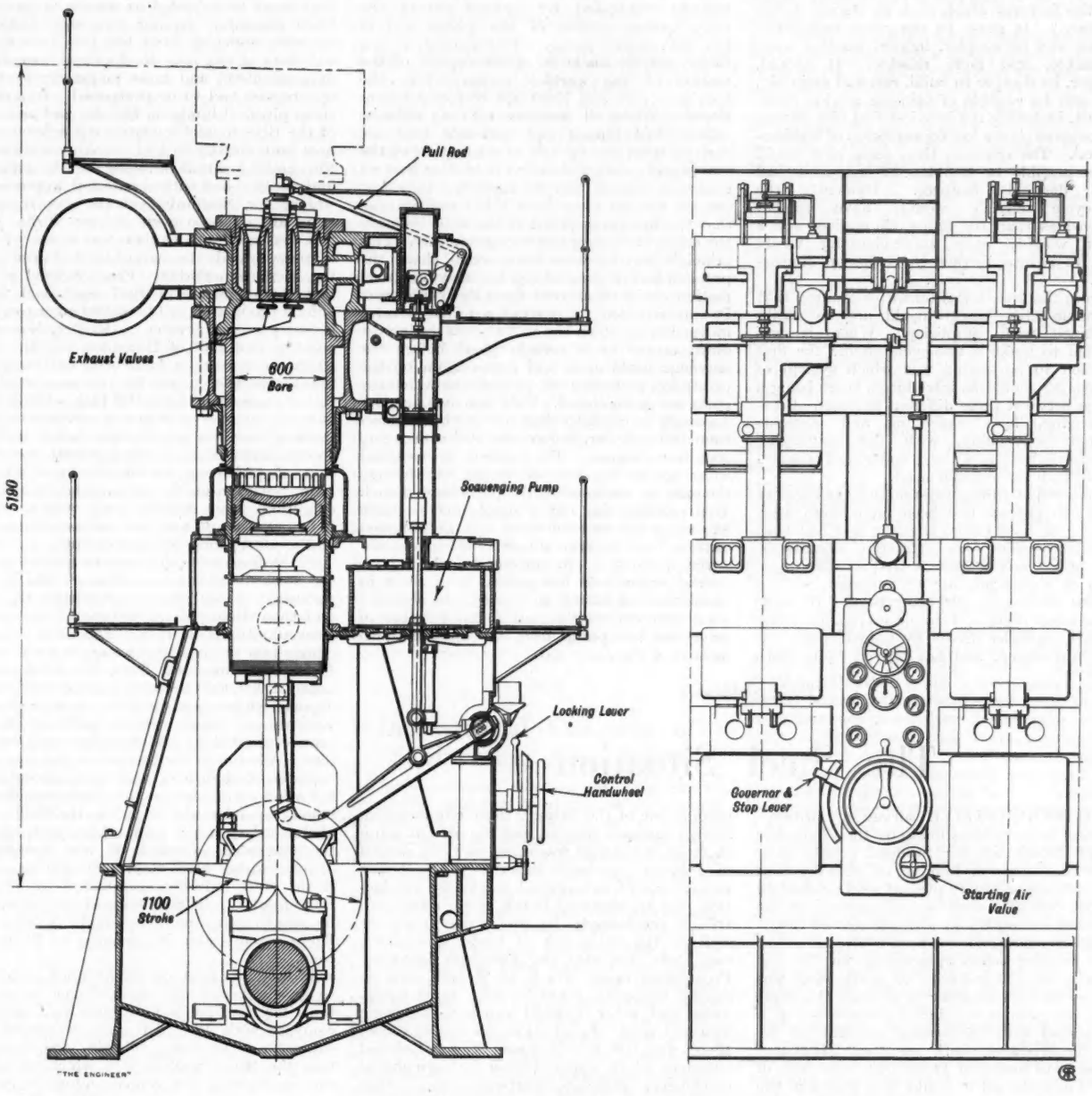
world was quite unknown. It was, however, assumed that in that branch of engineering development the countries at war were not at least neglecting progress. The question arose whether new developments in normal diesel engine design were taking place outside Holland which might render obsolete the old, well-tried four-cycle Werkspoor engine, with under-piston supercharging. In view of this possible threat, Mr. Lugt tried to work out the probable lines of advance and set himself the task of creating a new engine, which would, after the war, take the place of the old Werkspoor engine and thus maintain the prestige of Werkspoor in oil engine design and construction.

It can now be stated that the expectations of the progress of foreign design during the war were too high, a fact which is logical because the countries engaged in war production had no time to occupy themselves with new designs for large marine oil engines of moderate speed and high powers. For war purposes it was more valuable to have small high-speed engines which could be produced in large numbers. The majority of the new ships constructed during 1939–45 were steamers, and comparatively few large diesel engines were required. In the main, existing types of engine were used, for which the patterns and drawings were at hand, and for which shop procedure was known.

In this branch of engineering radical departures from accepted designs were not attempted. It may be remarked that the engines illustrated in the advertising pages of the technical journals did not change, and were in general of pre-war design. To its surprise, Werkspoor found that it was the only firm which was planning to come forward with an entirely new engine. The working out of the design and the preparation of drawings was impossible during the German occupation, and this work had to be postponed until the end of the war.

In May, 1945, a start was made with the construction, but the underfed and ill-favoured state of both staff and workmen made progress slow, which accounts for the two and a half years which elapsed before the new engine was ready.

However, at the end of the war, all preliminary plans which Mr. Lugt started on single-handed in almost monastic seclusion, in 1943, were ready. Every precaution had to be taken to keep the new ideas embodied in the design from the prying eyes of the Germans. All designing and model making had to be done with the utmost secrecy. Happily, Mr. Lugt's own office was very seldom visited by the German officials in the Werkspoor factory, which made it possible to proceed quietly with the work. This procedure was very different to that of normal times, when the designing of a new engine is usually the result of team work on a large scale, very often hurried, by the necessity of having the drawings ready for the works, which are always clamouring for "blueprints," or are scared to depart from the time schedule programme.



SECTIONAL ELEVATION OF EXPERIMENTAL ENGINE

This time the proceedings were quite different and Mr. Lugt could take his own time instead of being satisfied with a solution which did not give the certain feeling that the utmost simplicity had been arrived at. Thus, in the last war years, 1943–45, the complete design of the new engine was virtually finished. During the experimental period, however, some changes in construction were made. It may be here recorded that there was no part of the engine which was not personally designed by Mr. Lugt.

The following were the main principles which formed the basis of the new design. Twenty

or more years ago, when the marine diesel engine was still in its infancy, most designers and shipowners thought that the outstanding feature of each engine would be melted into a "unit type" engine, such as happened with the reciprocating steam engine. The progress, however, advanced on different lines. To-day there are more varieties of marine oil engines than one can count on the fingers of two hands. All the same, it is difficult to break away from the impression that it should be possible to construct one engine which combines as far as possible all the best attributes of the varied existing designs. This was the ideal type of engine which Mr. Lugt sought to realise. What are the features which such an engine should embody? It must be the most economical engine and be simpler, lighter, smaller, more accessible, and more reliable. It should, further, be cheaper to build, run and maintain, and also be capable of utilising a wide range of fuel, including the heaviest fuel oils, having at the same time a low consumption of lubricating oil. The question then arose how would it be possible to combine in one design all these desirable features. Evidently the two-cycle engine would have smaller dimensions than the four-cycle engine, with a lower weight, while super-charging would tend to reduce further the cylinder dimensions.

From the first it was taken for granted that a double-acting design could not be easily combined with simplicity. When it was decided to make a two-cycle engine the first question to be settled was which system of scavenging should be introduced, there being a choice between three different systems. Cross scavenging, loop scavenging, and straight-through scavenging, with the scavenging ports in the bottom of the cylinder, and exhausting through the cylinder head.

The straight-through system (now an obsolete American patent) had been increasingly used in the year just before the war and had been found to possess some attractive advantages. One of its advantages is that smaller quantities of scavenging air are required, with a smaller scavenging air compressor. In some of the latest designs, a simple scavenging pump on each cylinder driven by linked beams has been introduced, and has proved to be both lighter and cheaper than the separate scavenging pump unit at the forward end of the crankshaft. The total overall length of the engine has been thereby reduced.

It will be clear that the straight-through scavenging principle embodies valves or sliding pistons in the cylinder head, which entail means to move them.

An obvious solution is the provision of a chain or gear driven camshaft with ahead and astern cams, and a reversing engine. This system is however, rather complicated and may be somewhat noisy. In the Werkspoor-Lugt engine (see the accompanying sectional drawing) such a gear has been entirely eliminated by making use of the reciprocating motion of the piston rod of the scavenging pump. This motion, it was found, can be made an exact replica of the motion of the working piston when the rocking levers and links are correctly dimensioned. When all motions such as exhaust valves, fuel pumps and indicator gear are derived from the up and down motion of the scavenging pump piston rod it is clear that no reversing motion will be needed. This fact can be seen at once from this consideration, that the motion required is the same whether the crank is running one way or another. This principle having once been made clear, the problem had to be faced how the unsymmetrical motion could be derived from the piston rod. It was required to provide a form of valve movement in which the valve opens during the down stroke at a certain point before the scavenge ports open and closes again on the up stroke, preferably at the point at which the ports are again closed. This first movement is necessary in order to clear out the burnt gases from the cylinder, before the real scavenging operation begins. The second is essential so as not to lose any scavenging air through the exhaust valves after the ports have closed. This problem was not a simple one to solve and many different solutions were investigated until at last the very simple solution was discovered, which is now embodied in the experimental engine and has proved both silent in operation and reliable in service. In a somewhat different way it was found possible to drive the fuel pump from the up and down motion of the same rod.

(To be continued)

The Steel Situation

A COMPREHENSIVE survey of Britain's steel situation was made by the Chancellor of the Exchequer, Sir Stafford Cripps, at a Press conference in London on Monday last. He dealt not only with present steel production trends, but also with several aspects of the increased demands and with the revised distribution scheme which has been evolved.

Sir Stafford began by pointing out that the capacity of the industry to finish steel was greater than its capacity to produce the crude steel, but even so the finishing end was not in full accord with the present demand for the various products, with resultant shortages. If the 1948 target of 14,000,000 ingot tons of steel was achieved it would be a record in the history of the British steel industry, and yet there would still be a severe shortage which made it necessary to do everything possible to exceed the target. The many increased demands for steel, Sir Stafford continued, could be related to the need for improved equipment of the country's basic industries, to technological change, and to the vast needs of export and import saving programmes. In reaching the overall export targets, the machinery and electrical industries were carrying a very large share of the burden and must continue to do so. Together, they accounted for one-fifth of all our exports in the first eleven months of last year compared with one-seventh over the same period of 1938. The Mercantile Marine must also be built up and maintained since shipping had always been and must again become one of the nation's most remunerative foreign currency earners, and the present acute shortage of tonnage was reflected every month in reduced "invisible exports." The heavy programme of agricultural machinery production was an essential factor which must contribute increasingly to the export trade as well as the expansion of home agriculture, and there was also the European Recovery Programme under which we should want to supply European countries with farm equipment and other finished products requiring iron and steel. In addition, Sir Stafford said, there was the development of our Colonial resources which required steel for agricultural machinery, railways, harbours and other capital equipment including industrial buildings and plant.

All this meant, Sir Stafford explained, that in 1948 we could use for essential purposes alone 11,500,000 tons of finished steel, a figure which must be compared with an estimated availability of 10,500,000 tons, and we should in fact be short of at least 1,000,000 tons of finished steel. It might be asked, therefore, why it was proposed to export 1,000,000 tons of steel in 1948. It was not merely a matter of needing to earn the foreign exchange represented by that quantity, but in many of the bilateral negotiations which we must conclude, there were many instances in which we could not get negotiations on their feet unless we could offer other countries some quantity of steel or steel goods. Steel, Sir Stafford asserted, was not only an essential bargaining counter as a means of payment for imports; it was also the vital material for building up the productive strength of our own manufacturers and the buying power of our customers throughout the world.

Sir Stafford then went on to deal with the subject of steel supplies, saying that the extent to which we should be able to supplement home production by imports during 1948 and afterwards was necessarily subject to a number of factors which could not be foreseen precisely at present. At the moment it was being assumed that we might be able to import something over 500,000 tons of ingot steel in 1948, but that must be regarded as merely an approximate estimate. In our own steel industry, we were suffering from the fact that during six years of war new development was almost at a standstill and most major replacements and repairs had to be postponed. In spite of these physical limits on the size and character of the British steel industry, the achievements now undoubtedly looked encouraging, and for the climbing output of recent months managers and workers had earned national appreciation which, Sir Stafford said, he hoped would stimulate them to even greater efforts. The fact that much of the plant was in urgent need of renewal made the current level of production the more remarkable. From a level in the first three-quarters of 1947 equivalent to an annual production of 12,000,000 ingot tons, the industry was producing in October, November and the first half of December last the equivalent of more than 14,250,000 tons, with the result that the output for the year would be rather more than 12,500,000 tons. The acceptance by the steel workers of continuous shift working had been an essential factor in lifting the output level and fulfilled at least one condition of producing 14,000,000 ingot tons in 1948, but even on the assumption that all the conditions were fulfilled, the output of the industry at its present level with existing plant was seriously short of requirements.

Sir Stafford next outlined the revised system for steel distribution, details of which were published in our issue of December 12, 1947, and then discussed the nature of the overall steel allocations in 1948. The likely level of demand for finished steel would be round about 11,500,000 tons, and from the total supply nearly 1,000,000 tons must be allowed for steel exports, while exports in the form of machinery, vehicles and other manufactured goods had been estimated at about a further 2,000,000 tons. Allowances for this latter purpose were, however, included in the total allocated to home industries, and on that basis the effective home demand could be put at 10,500,000 tons of finished steel this year. Last year, against the equivalent demand, it was possible to allocate rather more than 8,000,000 tons, and if the steel industry maintained its present rate of output, Sir Stafford said that we should be able to move more than halfway from that figure towards the full demand of 10,500,000 tons.

It was only possible, Sir Stafford continued, to give a broad indication of how the allocations for the first half of 1948 were likely to compare with 1947 deliveries in certain key categories. It was probable, for example, that the Ministry of Supply, which sponsored the engineering and vehicle industries, would be allocated rather more than the 1947 deliveries, while for consumer goods the Board of Trade would get a little above last year. Agricultural machinery manufacturers would receive a very substantial increase, but it should be noted that the total increase would be allocated in varying proportions to individual firms according to the contribution they could make. The Ministry of Transport would receive an important addition to its 1947 figure, though it should be borne in mind that some of the railway requirements would be included in the Ministry of Supply figure. A useful increase would be made in the direct allocation to the coal mines; but here, again, the Ministry of Supply figure included an allowance for the manufacturers of certain mining equipment. To implement

the programme for new power station capacity, the electricity industry also might expect to receive a very substantial excess over the 1947 deliveries. All these additions, however, would exceed in total the expected increase in supplies and certain adjustments would therefore be necessary on the other side of the scale. The greatest of those would be in the allocation for new building, and was a direct consequence of the cuts in capital investment, as a result of which factory and Government building would suffer something like a two-fifths reduction in steel supplies. The other notable reduction, Sir Stafford stated, would be in the allocation to the shipbuilding industry, and would be something approaching one-fifth of the 1947 deliveries. The gas industry also would suffer and would receive a little less than last year.

The concluding portion of Sir Stafford's statement was devoted mainly to current and future steel production prospects. An output of some 14,000,000 tons of ingots, he said, was within the physical capacity of the industry, given sufficient raw material, fuel and transport. He pointed out, however, that to produce this tonnage during the twelve months a substantially higher output would be necessary at certain periods—a rate of 14,500,000 or even 15,000,000 tons to compensate for the periods when production fell below 14,000,000 tons. The supply of raw materials meant that there must be sufficient ore and coke for the blast-furnaces, pig iron and scrap for the steel makers, ingot for the rolling mills, and enough semi-finished steel to make use of the available finishing capacity. Similarly, there must be sufficient transport to maintain a steady flow between those various sections of the industry and their customers. The prospects for coke and scrap had both improved over recent weeks, though not so much as to remove the need for anxiety, although improved output from the mines justified the hope that enough coking coal would become available to supply the 12,000,000 tons of coke of the right quality needed, and there was no obvious reason why the coal could not be carbonised. The return of scrap had also been accelerated since the recent appeal made by the steel industry, and deliveries to steelworks were now running at 10 per cent higher levels than a year ago. We must, however, look to overseas sources, Sir Stafford said, for the balance of about 1,000,000 tons of scrap which was the estimated requirement if all home sources were fully tapped and blast-furnaces produced their maximum output of pig iron. There was no surplus of scrap in the U.S.A., but there were ample supplies available in Germany both to satisfy the German steel industry and leave substantial quantities free for export. It was hoped to get as much as possible from this source, but the difficulties, such as collection and transport, were formidable.

Having disposed of the threats to the achievement of the 1948 steel target, Sir Stafford commented on the possibility of exceeding it. It was, he said, principally a matter of finding supplies of coke and scrap in sufficient quantities. There might well be also an opportunity for expansion by raising the efficiency of existing plant capacity through a number of particular adjustments, such as improvement in furnace practice, increased production at the melting stage by the use of oxygen and by adjustments in the mechanical equipment of the shops, and in the semi-finished section by relatively minor changes in auxiliary heating and handling plant. All those possibilities were now being reviewed by the industry, for there was nothing that would do more and hardly anything that could do as much to relieve our present difficulties and strengthen the long-term position of the country as a further increase in steel production.

Finally, Sir Stafford said, the urgency of present needs must not be allowed to obscure the vital importance of the long-term expansion programme on which the steel industry was engaged. The plan prepared by the industry catered, during a period of about seven and a half years starting from 1946, for an increase of ingot steel production of about one-seventh, and within that increase for replacement of old by modern plant of approximately two-sevenths. Already considerably more than half the plan had been approved in detail by the Iron and Steel Board, involving an expenditure at current prices of nearly £12,000,000. In addition, about another sixth had been approved in principle to be undertaken in its proper order. The programme as originally drawn up had been under continuous review by the Iron and Steel Board, and was now being further reviewed in the light of the Capital Investments Programme for 1948. All concerned were fully apprised of the need to go ahead with the work as rapidly as possible.

The Advisory Committee on Atomic Energy

At the end of last week it was announced from 10, Downing Street, that Sir John Anderson had tendered his resignation from the chairmanship of the Advisory Committee on Atomic Energy in view of the fact that the purposes for which the Committee was established, at a time when continuity was of the highest importance, had largely been fulfilled. The Prime Minister, it was stated, agreed with this view and has expressed his warm appreciation of Sir John's services as chairman and of the valuable work done by the Committee during the past two years. The Government has come to the conclusion that, in view of the progress made, and of the establishment of other advisory bodies, there is no longer any need for the Advisory Committee on Atomic Energy to remain in being. Advice on the day-to-day operation of the programme of atomic energy development is now obtained through the machinery of the Ministry of Supply, and, on the broader scientific aspects of atomic energy development, the Government can appropriately look for advice to the Advisory Council on Scientific Policy and the Defence Research Policy Committee, which are both under the chairmanship of Sir Henry Tizard. With this arrangement in view, it is stated that the appointment of an additional physicist to the Advisory Council on Scientific Policy is under consideration.

International Congress of Engineering Manufacters

The Technical Division of the British Engineers' Association announces and invites British firms to participate in a Congrès International de Fabrications Méchaniques, which will be held in Paris for four days in the beginning of October, 1948. Replies should be sent to Mr. P. B. Boyle, of the Technical Division at the British Engineers' Association, 32, Victoria Street, London, S.W.1, by January 27, 1948. The subjects will be chosen to show the development since 1939 of the general concept of manufacture in the mechanical field and the development since 1939 of the processing methods for materials. In the first section they include the development of ideas towards the use of lighter parts; the use of non-metallic materials and substances in mechanical constructions; economy in processed materials and improvements in the use of power and the developments in processes of manufacture, reducing wastage to a minimum. In the second section the subjects chosen will include the development of forming and cutting methods, mechanical finishing methods, the development of heat treatment and anti-corrosive measures. Offers of papers on these subjects are invited. The only essential point is that the papers presented should be generally instructive to practical industrialists who will attend the congress. The congress will comprise a limited number of sessions, with visits to factories. The Provisional Organising Committee seeks only a restricted number of papers and it expresses the desire that they should be confined to what is really essential within the framework outlined above.

Modern Cutting Tools and Machine Tool Design*

By C. EATOUGH, B.Sc.Tech., M.I.Mech.E.†

(No. II—*Continued from page 53, January 9th*)

Machine Design

There are already indications that great machine design difficulties are approaching due to efforts to increase the speed of machining, and as a direct result of this, methods of production are introduced which minimise the number of chip forming operations required; die casting, plastic moulding, powder metallurgy, pressing, and thread rolling are obvious examples.

In designing a lathe for use with high-speed steel, a range of spindle speeds has to be provided which is capable of giving efficient cutting speeds on work differing in diameter from the maximum which the lathe will swing down to the smallest size of bar to be turned. In addition, a range of low speeds has to be provided for screwing and forming.

The introduction of carbide turning tools necessitates the raising of the turning speeds by from six to eight times as much as before. If this has to be combined with a reduction in screwing speeds to suit the new alloy steels, the overall speed range of the spindle drive unit becomes very great indeed.

For cutting with carbide tools, the requirement of high power is associated with high speed and thus the stresses on the various machine elements need not be unduly high if the high speed characteristics are maintained throughout the driving train from motor to tool. In practice, it usually happens that stresses in a machine using carbide tools are appreciably lower than those encountered in the same machine engaged on conventional high-speed steel cutting, and this in spite of the fact that the output obtained from the machine when using carbide tools may be two or three times as much as the output when using high-speed steel. The new technique throws more emphasis on the ability of a machine to run fast than on the strength—as distinct from rigidity—of the machine elements.

Wide-range multi-speed gearboxes are costly to make and difficult to operate for rapid speed changing other than by friction clutches. Multi-speed motors simplify the gearbox problem by reducing the overall speed range of the gears, but such motors cannot operate at maximum efficiency and lose power appreciably at the lower speeds. Operational control of multi-speed reversing motors is very easy but frequency of speed changing and of reversing has to be considered if overheating of the motor is to be avoided. Certain classes of machines can operate efficiently with less power as the spindle speed is reduced, but others require full power over a wide range of speeds. An example of the latter class is the combination turret lathe which may be used at maximum power with carbide tools on small diameter work running at the top spindle speed whilst other work may necessitate maximum power for high-speed steel cutting at slow speed on work of large diameter.

Stepless speed control by electric, hydraulic, or mechanical means is very attractive at first sight, but for main drives on chip forming machines it is doubtful if such controls are of much practical advantage. The speeds of cutting tools are rarely critical and if speed control is by manual operation it is difficult to persuade operators to take the trouble to effect speed changes for short traverses unless a large variation is required.

Equipment with electronic control for use with large powers is costly and in any event gives only a partial solution of the machine tool drive problem of to-day.

Electronic control of direct current main-drive motors permits of stepless speed variation over a very wide range, but constant power is usually available over a comparatively narrow range of about 4/1 at the higher speeds, after

* Abstracted from a paper presented to the Institution of Mechanical Engineers, on January 2, 1948

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which the power falls on the basis of constant torque. Thus at the low speeds little power is available. Low power at low speeds is suitable for many feed drives and electronic control in its present form is well adapted for this work.

On special purpose machines and machines running on restricted ranges of operations, the gearbox design problem can be simplified by the use of slip gears. Such designs give a wide overall speed range with a narrow choice of speeds for operational use at each set-up; the limited speeds available being changed electrically by multi-speed motors which may be combined with friction clutch changes of constant mesh gears.

At high speeds, crash gearboxes used in conjunction with a friction drive clutch have to be used with a fair degree of skill if heavy maintenance costs are to be avoided. Time has to be allowed for the gear speeds to fall before speed changes are effected, but for easy changing the gears must not come to rest.

Speed changing by the use of friction clutches in conjunction with constant mesh gears, permits unskilled and rapid operation, and in a still more advanced form pre-selection of speeds and electric operation by push button are possible.

The machine tool drive problem to-day has not been completely solved and the best service which the tool research engineer could render to the machine tool designer would be to concentrate on work which would lead to permitting increases in the operational speeds of the low-speed tools such as drills, taps, dies, reamers, and form tools to bring them into line with the carbide turning tools. An increase in the cutting speed of the low-speed tools would reduce the speed range of the main drive gearbox and so give more flexibility in design.

High cutting speeds are desirable as they permit rapid feeds and thus give increased production but of late years there has been a tendency to expect high rates of production combined with greater dimensional accuracy and improved surface finishes from chip forming operations of all types.

Carbide tools have helped appreciably in giving better finishes on the work and in increased production, but special precautions may have to be taken to maintain dimensional accuracy.

Cratering and Tool Design

Tools for bar turning are best arranged with the cutting edge at right-angles to the bar axis so as to produce a square face at the end

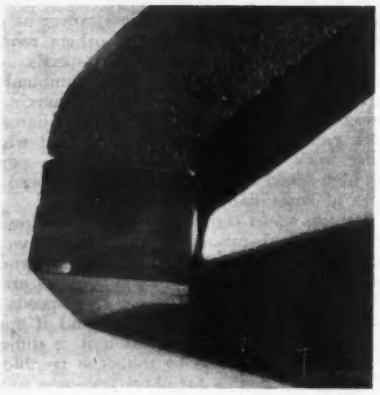


Fig. 1—*Typical Crater on Top Face of Turning Tool*

of the cut. A flat topped tool with the cutting edge placed in this manner directs the chips on to the completed part of the work and so damages the finish.

The grooved tool rolls the chip into corkscrew formation which flows away from the work, the direction of flow being nearly perpendicular to the work axis. The tool thus has the advantage of producing square shoulders of minimum length of active cutting edge and of promoting chip flow away from the finished work surface.

The cutting action of the tool is most efficient and this is reflected in long tool life between grinds and in lower power consumption per cubic inch of material removed per minute.

The reason for the high cutting efficiency of the tool is that as little work as possible is done on the chips after they have been sheared from the parent metal. The chips take up a

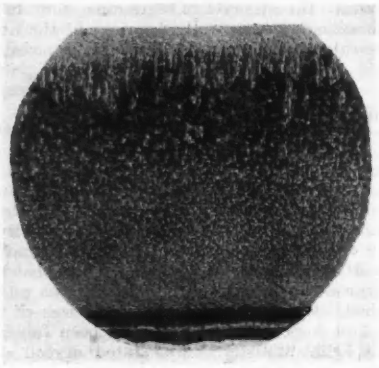


Fig. 2—*Crater Formation after Machining of 50 Peripheral Feet*

natural spiral formation, the shape of the coils depending on the difference of the diameter of the bar before and after turning. The angular groove in the top face of the tool acts as a chip curler and is so dimensioned that the coils fit into the groove and are supported until they are well clear of the work, tool, and rollers.

There is still much doubt as to what happens at the edge of a cutting tool when in use at high speed, but it would appear that the working conditions adjacent to the edge of most turning tools used on soft steels are less severe than they are farther away from the edge.

A flat-topped, straight-edged tool of conventional shape begins to show signs of cratering almost as soon as it is put into use.

Fig. 1 shows a typical crater formed on the top face of a turning tool; the familiar "D" shape will be noticed, this being formed due to the uniform load and speed conditions, which obtain in the centre of the cutting edge, being altered at the ends. At the end adjacent to the finished bar surface the crater shape is affected by the chip flow from the tool nose radius, and at the other end of the cutting edge the chip pressure is relieved by the possibility of the chip being able to flow sideways for a small distance.

The formation of a crater is shown by Figs. 2 and 3. These are enlargements of the top surface of a lathe tool and represent sections at right-angles to the cutting edge, the latter being the dark horizontal line at the bottom of each section.

The tool of 45 deg. approach angle, and 10 deg. negative top rake at right-angles to the cutting edge, was used for machining a 0·40 per cent carbon steel bar at 800ft per minute cutting speed with a feed of forty cuts per inch. The tool, with a tip of a hard grade of carbide suitable for steel cutting, was carefully lapped on both top face and front clearance face with a 400-grit bakelite impregnated diamond wheel.

The typical outline of a crater is apparent after a very short run and at first takes the form of the crater area slightly pitted all over; the spaces between the pits being practically undamaged tool surface. Further running increases the severity of the pitting and eventually the pits unite to form a complete crater, which enlarges as further cutting takes place.

It will be seen that between the cutting edge and the crater is an area of the tool top surface which is almost undamaged.

Fig. 2 was taken after fifty peripheral feet of material had been machined. On the tool the outline of the crater was clearly visible to the naked eye. The enlargement which represents about $\frac{1}{16}$in of the cutting edge, shows that pitting has started, but the scores which run vertically upwards on the picture are restricted to the portion of the tool top surface where the chip commences to curl away from the tool in order to escape.

Fig. 3, to the same magnification as the previous figure, shows the complete failure of a well-defined area, with a little scoring on the ingoing edge and heavy scoring on the outgoing edge. The tool shown in Fig. 3 had completed a total turning distance of 150 peripheral feet. The good condition of the land adjacent to the cutting edge is in striking contrast to the conditions farther back.

When a definite crater has formed, the rate of failure of the tool appears to diminish. The crater gradually increases in size, the outgoing side wearing at a greater rate than the ingoing side. This is fortunate as it means that the diminution in width of the area with little damage adjacent to the cutting edge, is not rapid. If this land becomes too small, the crater breaks through to the cutting edge and causes complete failure of the tool edge.

Fig. 4 shows the results, on size of crater and width of land behind the cutting edge, of cutting 0·40 per cent carbon steel at 800ft per minute with varying feeds. Hard-steel-grade carbide tools were used. These had 45 deg. approach angle and 10 deg. negative top rake at right-angles to the cutting edge.

In all tests a uniform distance of 1320 peripheral feet was cut. The speed chosen was higher than usually used in production, but was in line with other work which had been done in connection with machinability tests, where accelerated failure was used as a measure of machinability of different materials.

It will be noted that higher feeds give larger land widths but proportionally greater craters.

Fig. 5 shows the corresponding relationship between crater and land for similar conditions but using constant feed of 40 cuts per inch and variable speeds.

Low speed and high feeds clearly indicate maximum tool life and it is interesting to compare this with results from high-speed steel tools, where the same obtains but much farther down the speed scale.

In originating cutting data for application to production, the cost of tools and of reconditioning them must be considered.

Conditions vary in each machine shop and with each type of tool, but experience with carbide tools of the type tested, when operating on unscaled 0·40 per cent carbon steel, has established 550ft to 600ft per minute as an

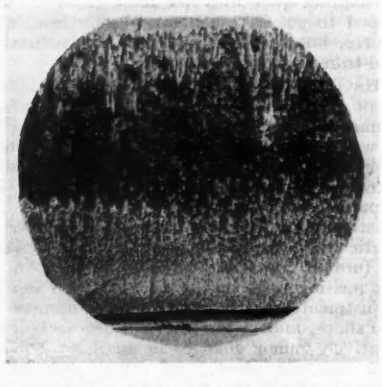


Fig. 3—*Tool after 150 Peripheral Feet of Machining*

economic speed. The determination of the ideal speed is more important than feed, since the rate of increase of crater width with respect to speed is greater than with respect to feed, and in any event the maximum feed which can be used is often determined by the rigidity of the work.

At 600ft per minute with a feed of forty cuts per inch, the rate of crater growth with respect to the total distance travelled in the cut is as shown in Fig. 6.

The crater increases in size very quickly at the start, but the rate of growth decreases with greater distances cut.

On the 0·4 per cent carbon steel tested, 20,000 peripheral feet is about the most which can be expected to be cut per tool grind as, at this distance, the crater growth begins to cause weakness of the tool edge and the point of breakage is near.

The crater width of 0·080in which can be expected at this point of 20,000ft travelled, corresponds to a depth of about 0·016in,

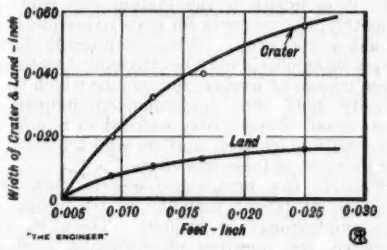


FIG. 4—*Relationship between Widths of Crater and Land and Feed*

and this represents the minimum amount of carbide which has to be ground off the tool top face before it can be put back into service.

The cutting land on the top face of a cutting tool is reduced as the crater increases in size, and it is also reduced by wear on the clearance angle face below the cutting edge.

Wear on the clearance face is affected very much by lack of rigidity of either tool or work and is subject to most erratic variations. It is difficult to measure with accuracy and forms a very unsatisfactory means of judging tool performance when cutting steel.

If the cratered area performed some useful service in supporting the chip during its passage across the tool face, it would be reasonable to assume that the crater is formed by abrasion, but the natural tendency of a chip is to curl upwards away from the tool face and this curling tendency still persists even when the portion of the top face of the tool, which would normally be cratered, is cut away as it is with the grooved type of tool.

The grooved type of tool is essentially a flat-topped negative-rake tool with a V-groove so positioned as to leave a narrow land parallel to the cutting edge.

The groove runs out on the cutting face, leaving the nose radius intact and removing the area which would normally become cratered

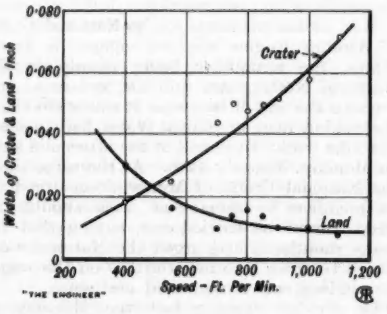


FIG. 5—*Relationship between Widths of Crater and Land and Speed*

in use. The chips still curl upwards without causing much sign of heavy pressure on the back edge of the groove.

The main portion of the chip does not flow down to the bottom of the groove but slides across it by resting on each edge. Near the nose radius the groove becomes very shallow, and at the nose radius there is no groove at all. As would be expected, cratering does occur about this portion of the tool face, but as the groove becomes deeper and wider farther back from the nose, the chip eventually bridges the gap.

The absence of the cratered area on a grooved tool appears to have a bearing on the tool efficiency and it may well be that the friction induced by a chip passing at high speed over a rough cratered area causes a complete change in the cutting conditions and so affects the power required and also the formation of the chip. As the chip normally curls upwards, the initial formation of a crater is more likely to be due to chemical attack and welding than by heavy mechanical abrasion.

The high production capabilities of carbide tools, and the difficulties of handling and breaking the chips, are responsible to some extent for the present tendencies to simplify tooling and even to revert to single tool cutting.

Recent developments in cutting tools have produced tools which are very brittle and capable of carrying little tensile loading. One result of this is that the failure of a carbide tool by breakage is likely to be disastrous, and a mishap which, with a high-speed steel tool would necessitate a regrind, may well scrap a carbide tool completely. Less liberties can be taken with modern cutting tools, and the speeds and feeds under which they are to work have to be more rigidly controlled.

Bar machines present special problems in the application of modern cutting tools; cutting speeds are high and work diameters are small, so that fast rotational speeds are necessary. The requirement for a wide speed range for screwing and forming has already been mentioned but another major problem remains, due to the difficulties resulting from rotating

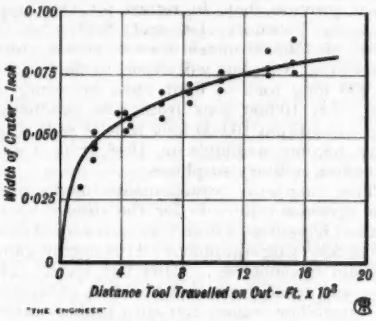


FIG. 6—*Relationship between Width of Crater and Distance Tool Immersed in Cut*

long bars at high speeds. Special precautions have to be taken in centralising the tail ends of the bars and heavy chucking is necessary if the chuck grip is not to be loosened by the whirling of the bar when running. The rapid operational cycle makes it advisable to provide power operation of the chuck and of the feeding of the bar stock.

Conclusion

It is practically impossible to forecast the results which might be expected from a long production run by testing a few samples.

Much experimental work has been done on cutting tools by taking repeated tests on bars and flat test blocks. This is a very different condition from the usual production work where surface scale and imperfections are encountered on every component.

The true value of the performance of a cutting tool must take into account the cost of regrinding the tool after use, and with carbide tools the cost of sharpening may well be considerable. This is particularly so with milling cutters. Much can be done to cheapen the cost of tool sharpening if the tools are designed in such a way that the minimum amount of carbide has to be removed when sharpening is necessary.

Many tools are badly designed from the point of view of economy of carbide and of subsequent regrinding. There is rarely much virtue in large tips; they are high in first cost, difficult to braze without cracking, and have to be handled with great care when grinding.

Carbide tools are difficult to grind and there is room for much work in this field. The cost of tool grinding is an essential part of the cost of production, and excessive grinding cost frequently precludes the full application of modern cutting tools. A certain amount of success has resulted from the use of coarse grit diamond impregnated grinding wheels running at peripheral speed as high as 10,000ft per min., but the rate of carbide removal is still very low compared with what can be expected from high-speed steel grinding.

Unbalanced progress in the development of cutting tools has left the production engineer and the machine tool designer in a somewhat difficult position.

Economic speeds for some tools have advanced tremendously but the operational speeds of other tools have made little progress. What is now most urgently needed is tools of the carbide type but with greatly increased toughness, heat resistance, and abrasion resistance. Given these qualities the most difficult problems would approach solution.

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria Street, London, S.W.1.

HOSE CONNECTIONS FOR WELDING AND CUTTING APPLIANCES

No. 1389: 1947. This standard has been prepared to fix the size of hose connections used in welding and cutting in order to facilitate a change in the size of a cutting or welding blow-pipe, or an interchange between the two, with a minimum change of hose. In the past, some difficulty had been experienced because it was found that when effecting a change in the size or make of blow-pipe, the hose had also to be changed. It is hoped that this standard may largely obviate such difficulties in the future.

Three sizes have been standardised as these should cater for the vast majority of applications. The sizes are ¼in, ⅜in and ½in B.S.P. The standard deals with the connection at the inlet end of the blow-pipe, the hose coupling nut and the hose coupling nipple. A range of three reducing hose couplers for connecting together unequal sizes of hose is also included and comprises ¼in to ⅜in, ¼in to ½in, ⅜in to ½in. It is required that he thread on hose connections, coupling nuts and couplers for the oxygen supply shall be a right-hand thread, whilst that for fuel gas supply shall be a left-hand thread. Coupling nuts and hose couplers having a left-hand thread are notched. The standard includes line drawings of the fittings covered together with full tables of dimensions. Price 2s.

PHOTO-ELECTRIC EXPOSURE METERS

No. 1383: 1947. This standard, which is the outcome of a wide programme of investigations by a B.S.I. Committee, depends upon the standard method of determining the speed of photographic negative material specified in B.S. 1380, and has been published to provide the basis for development of post-war photo-electric exposure meters which will give satisfactory service to users. It describes the basic principles of exposure meter design and gives recommendations on calibration and upon acceptance angle, together with methods for calibrating and determining acceptance angles. It prescribes the scales to be employed and the method of determining the markings for these scales. The standard also specifies the effective range for the pointer and the standard of accuracy required, together with a limit for time of response and limits for errors owing to fatigue due to tilting or to change in temperature. Price 2s.

FLAME-PROOF ELECTRIC LIGHTING FITTINGS (BULKHEAD AND WELL TYPE)

No. 889. This standard was first issued in 1940. It set out the maximum permissible gaps for flame-proof joints and requirements for bodies, fittings, types of lamps, lamp holders and glasses. Details of tests required were also given and notes on fittings, securing bolts, cement and permissible temperature rise. In the 1947 revision of the specification an Appendix has been added which prescribes dimensions for six sizes of well glasses which it is recommended should be adopted as standard in order to facilitate manufacture and effect economies in production. A further Appendix has been added giving details of the flame-proof mark and the procedure to obtain authority to use the mark. The dangerous atmospheres covered are: Group I, Methane; Group II, Petroleum vapour and acetone vapour; Group III, towns gas or coke-oven gas with not more than 60 per cent hydrogen content. Acetylene and carbon disulphide are excluded and investigations are being carried out with regard to the inclusion of other gases. Price 3s., post free.

Industrial and Labour Notes

Engineering Production and Costs

On Wednesday of last week the Chancellor of the Exchequer held the first of this year's Press conferences on the economic situation, and in surveying events of 1947 took the opportunity to refer to the contribution to the export drive which is being made by the engineering industry.

That industry, Sir Stafford said, although hampered by steel shortages, in addition to achieving in some classes record export figures, was making a marked contribution to increased productivity by its supplies of new equipment to home industry. Exports of the combined machinery, electrical goods and vehicles industries were now running at nearly twice the 1938 volume; and exports of machine tools were two and a half times the 1938 average, although it should be noted that two-thirds of the metal-working tools made and three-quarters of the wood-working tools went to re-equip British industry. Agricultural machinery firms, Sir Stafford added, although supplying four times the quantity for export that they did before the war, were making three-quarters of their output available for British farmers. The production of coal mining plant in 1947 was also very satisfactory, and the results achieved in the production of heavy electrical generating plant showed that a very good job had been done.

In other parts of his statement, Sir Stafford again referred to the matter of production costs. We must, he said, set about reducing costs as vigorously as we could, and whilst maintaining wages, we must economise in production costs by better methods. Improvements of design could ensure that less effort produced the same result and the detailed planning of production could reduce delays and consequently costs. The widespread nature of the increases in weekly wage rates, Sir Stafford continued, was a source of concern amid the increasingly competitive conditions under which we were selling our manufactures abroad, and their only justification in present circumstances was if they yielded better results in the general overall productivity of industry.

Efficiency of production, the Chancellor concluded, was still a cardinal need. There was, he asserted, a great deal that could be done by agreement between management and workers, by getting rid of all hindrances to production, by using new methods and by a redeployment of labour. We were nowhere near the maximum production that could be got from existing machinery, quite apart from the improvements that were being made daily in industrial equipment. The most urgent task was that managements and workers should get together to get the very best out of existing resources.

Coal Production Costs

The National Coal Board has now published a statistical statement setting out the costs of coal production, proceeds and profits of collieries in Great Britain for the first and second quarters of 1947. It shows that in the first quarter of last year the total cost of production of the 46,188,192 tons of saleable coal obtained was £87,644,943, and that the proceeds of sale were £89,619,752, thus leaving a profit—before charging interest—of £1,974,809. In the second quarter, however, the cost of producing 45,859,253 tons of saleable coal was £92,687,342, and the proceeds of sale were £88,966,666, so that a loss of £3,720,676 was incurred. According to the Board's Director General of Finance, the principal reason for the loss in the second quarter was the introduction of the miners' five day week in May, with consequent increased costs which were not covered by higher coal prices until September. He also stated that the annual interest charges on the National Coal Board, including interim payments to private owners, were running at approximately £13,000,000 a year.

With regard to wages, the statement shows that in the first quarter of 1947 the total amount required for wages, including holiday pay and allowances in kind, was £57,309,641, or 24s. 9·8d. per ton of saleable coal. In the second quarter, wages totalled £60,335,359, or 26s. 3·9d. per ton. The average weekly earnings per wage-earner, including underground and surface workers of all ages, were £6 13s. in the first quarter and £6 14s. 11d. in the second quarter. For underground workers the average weekly earnings, including value of allowances in kind, were £7 0s. 8d. in the first quarter, and £7 3s. 4d. in the second quarter. Expenditure on roof supports, general stores and repairs amounted to £11,604,144 in the first quarter and to £13,529,460 in the second.

The Anglo-Russian Trade Agreement

The text of the recently concluded Anglo-Soviet Trade and Payments Agreement was published as a White Paper (Cmd. 7297) at the end of last week. It gives details of the British-manufactured machinery and equipment which will be purchased by the U.S.S.R. during this and succeeding years.

The short-term arrangements of the Agreement provide that, in return for the supply between February 1st and September 30, 1948, of 750,000 metric tons of coarse grains, the United Kingdom will export to the U.S.S.R. 25,000 long tons of light rails, including not less than 10,000 tons from new production, and in addition 10,000 long tons of rails which may become available in 1948 from United Kingdom military surpluses.

The long-term arrangements made under the agreement provide for the supply by the United Kingdom, within various specified times, of the following equipment: 1100 narrow gauge, 750mm locomotives; 2400 flat trucks, 2400 two and three-drum winches, 210 excavators, 54 caterpillar cranes, 250 auto timber carriers, 14 tugs, 4 dredgers, 200 locomobiles, 150 mobile diesel electric generators, 24 steam turbine sets, plywood equipment to the value of £1,050,000, timber mill equipment to the value of £400,000, scientific and laboratory apparatus valued at £150,000, 4 pile drivers mounted on pontoons, 1 electric dredger, ball mills, crushers and ore handling machinery, 3 railway steam cranes, 48 transformers, and other electrical equipment, including 300 electric motors, and 10 sets of oil-purifying apparatus.

Wages Policy and Incentives

The latest broadsheet to be issued by P.E.P. (Political and Economic Planning) surveys manpower movements. Although much of it traverses fairly familiar ground in commenting on the present strength of this country's labour force and on the future prospects for full employment, there are in the document some suggestions regarding wages and incentives policy which are particularly noteworthy.

It is pointed out that there are two main purposes for which incentives are required. They are needed in order to attract workers into the undermanned essential industries, and also to secure the greatest possible output by the workers in those industries. But, it is urged, not all incentives are of equal value for the two immediate purposes. A time-rate, for example, may attract a worker to a job but will have little effect on output. If a material incentive can be found, however, which is sufficiently powerful to attract workers into an industry, it may be possible to apply it in such a way that the full benefits can be secured only in return for a specified minimum output.

The survey expresses the view that some sort of a wages policy is overdue, but in saying this does not demand a rigid schedule of differentials for application by rule of thumb. It is suggested that what is necessary is at least a few enterprising experiments. Private firms, it is stated, have made some interesting unofficial ones, and P.E.P. asks if it is not possible for the "authorities" to distil some sort of a principle from them which could be used as a basis for official experiments. It is acknowledged that a wages policy cannot, by itself, effect a mass redistribution of labour, but, it is urged, if the system was running smoothly, the necessity for mass redistributions would never arise. While impossibly large wages differentials may be necessary to attract large masses of workers out of jobs which they already hold into undermanned industries, quite small changes may succeed in removing deterrents which keep workers who are looking for jobs out of these industries.

Finally, the broadsheet asserts that the problem of labour mobility in conditions of full employment is twofold. There is, for instance, the question of attracting workers into the essential industries, and there is also the problem of persuading employers to release workers from the non-essential industries. According to P.E.P., experience seems to show that indirect controls, such as differential allocations of materials, are not very efficient for this purpose, and will in any case be difficult to maintain as materials become more plentiful. The suggestion is therefore put forward that an incentives policy must be supplemented by some device such as a differential tax on employers' wage bills. This idea, difficult as it might be to work out and administer, is, P.E.P. argues, one which is worthy of detailed discussion. It is admitted that any such device will depend for its success largely on acceptance by the workers of the aim of labour economy. A differential profits tax, it is added, might have psychological as well as material results, and therefore be more effective.

Colliery Engine Men's Dispute

A dispute has arisen between the National Union of Winding Engine Men and the National Coal Board over a wages claim and a request that the union should be recognised by the Board. It is estimated that there are 4000 winding engine men in Great Britain, about 1200 of whom are members of the National Union of Winding Engine Men. The remainder belong to the National Union of Mineworkers, which body the National Coal Board recognises as the one to negotiate on behalf of the mineworkers.

Most of the members of the National Union of Winding Engine Men are engaged in South Wales, the remainder being mainly in the Durham, Nottingham and Derby areas, and towards the end of last week it was stated that the engine men in South Wales had decided to strike work at the end of the afternoon shift on Monday, January 12th. At the same time, the National Union of Mineworkers urged all its members to remain at work should the strike threat be carried out, saying that for many months it had urged the National Coal Board to enter into negotiations on the wages of winding engine men and craftsmen.

On Friday evening last the Ministry of Labour stated that its officers had held full discussions with representatives of all the parties concerned in the dispute. The discussions had not resulted in a settlement; and in view of the serious effect on coal production that would result from a stoppage of work, the Minister had decided to appoint a Court of Inquiry to investigate the causes and circumstances of the dispute. This impartial Court, the statement continued, would be appointed under the authority of Parliament and the Minister of Labour expressed the hope that all concerned would refrain from any action which might be interpreted as being in disregard of its position. Following the Ministry of Labour's statement, the executive of the National Union of Winding Engine Men decided to suspend the strike notices.

French Engineering News

(From our French Correspondent)

PARIS, January 9th

Statistics recently issued by the S.N.C.F. show that from September 27th to October 3rd, 290,623 railway trucks were loaded on the national network. This number is 37,000 more than in the corresponding week in 1946, and 12,600 more than in 1938. Although the loads carried and distances worked by the trucks are much greater than in 1938, the S.N.C.F. is still short of rolling stock, which is 30 per cent less than that available prior to the war. At the beginning of October, demands made for 40,500 trucks could not be fulfilled, and unless new material is forthcoming a grave transport crisis may result.

* * *

The effects on industry of the constant tendency towards inflation have hardly been a stabilising factor in the country's economy, and the government's financial plans for arresting this inflationary movement have not been welcomed as the most efficacious method for solving the problem. A further series of cost increases is expected to affect most industries as soon as increased prices of coal, steel products, transport, salaries, &c., have been effected. The average rise in the price of coal, for example, is 500 francs, but it is thought that repercussions following on the changes of salaries and pensions may cause yet another price revision. Increases in iron and steel will include the increased price of coke, coal, ore, transport and other important expenses. Industrial merchandise will have to include the increased cost of transport, estimated at between 32 per cent and 35 per cent. In addition, general expenses have increased and social charges must also be taken into consideration. Whether the increased sales price will take into account the increased production costs and the consequences of reduced production due to the strikes, shortages of coal and electricity remains to be seen. In any case, salary increases are to be applied retrospectively from December 1st last year, and a cost-of-living bonus from November 24th. Industrialists therefore claim that they should be allowed to recover all these extra costs from increased prices. This will, in turn, affect the internal market. Exports are no less affected. There is at the moment a great disparity between French prices and the value of French money, and this is at the bottom of the country's economic unbalance. While there is no great enthusiasm for a differential rate of exchange for the franc, it is evident that exports cannot be maintained with prices as they are at the moment.

* * *

During the first half of 1947, monthly production of iron ore averaged 1,600,000 tons, with a labour force of about 23,000. About one million tons went to French steel plants; 140,000 tons to the Saar; 380,000 tons to Belgium, and Luxemburg; 20,000 tons to England, and 7000 tons to Holland. Stocks held at the end of June amounted to 8,700,000 tons. Production of iron during the first half of 1947 was 2,393,000 tons. Steel production reached 2,912,000 tons, of which just over half was Thomas steel. Figures for the first eleven months of 1947 show that compared with 1946 there has been an all-round increase and in some categories 1938 figures are being approached. Total pig iron produced in 1947 was 4,522,000 tons, against 3,067,000 tons in 1946 and 5,511,000 tons in 1938; crude steel for 1947 amounted to 5,338,000 tons, against 3,954,000 tons in 1946 and 5,703,000 tons in 1938; Thomas and Martin steel for 1947, 2,924,000 tons and 1,877,000 tons, respectively, against 2,049,000 tons and 1,452,000 tons in 1946, and 3,424,000 tons and 1,901,000 tons in 1938; sheet steel produced in 1947 amounted to 3,720,000 tons, against 2,679,000 tons in 1946 and 3,772,000 tons in 1938. There is still a considerable shortage in sheet metal, particularly as, before 1938, German rolling mills supplied a good proportion of French needs.

Notes and Memoranda

Rail and Road

INSTITUTE OF ROAD TRANSPORT ENGINEERS.—The North-Western Centre of the Institute of Road Transport Engineers is to be formally constituted at a dinner to be held at the Adelphi Hotel, Liverpool, on Thursday, January 29th, at 7 p.m. for 7.30 p.m. Members will have the opportunity of meeting the President of the Institute and other guests of the new Centre, including the officers of other technical associations in the North-Western region and representatives from manufacturers in the area. Tickets at 25s. each are available from Mr. H. Willmer, 44, Leyton Avenue, Prenton, Cheshire.

CORBY RAILWAY BRIDGE WIDENING.—A contract has been placed with the Butterley Company, Ltd., for the widening and strengthening of the bridge carrying Rockingham Road over the main Kettering to Nottingham line of the London Midland Region of British Railways, at Corby, Northants. This work involves the widening of the railway bridge from 25ft to 60ft, in order to accommodate a 30ft roadway and two 15ft footpaths. The existing bridge, a three-span brick arch structure, will be strengthened with reinforced concrete and the widened portions constructed with 125 tons of steel girders encased in concrete, and a reinforced concrete slab deck.

WESTERN REGION'S PERMANENT WAY WORK.—The permanent way programme to be carried out on the Western Region of British Railways during this year has been drawn up to include part of the two years' arrears of maintenance which it is hoped to clear off, with current work, in the next five years. On the assumption that the materials, particularly steel and wood, will be available, 490 miles of track—mostly on the main line routes—will be relaid, re-railed or re-sleepered. This work will involve the use of 33,000 tons of new rails, 750,000 sleepers and 250,000 cubic yards of ballast. If the supply of materials is insufficient, the arrears will be cut from the programme and the mileage reduced to 370. It is also intended to re-paint about 100 large and small stations throughout the system, as well as a number of railway bridges, and to repair or renew 260 miles of fencing and 1,000,000 square yards of roadway. It is estimated that the cost of the full programme will be in the region of £3,000,000.

Air and Water

THE COMMONWEALTH SHIPPING COMMITTEE.—The Ministry of Transport states that by the agreement of all the Governments concerned, the Imperial Shipping Committee will be known in future as the Commonwealth Shipping Committee.

THE LIFEBOAT SERVICE.—During 1947, lifeboats of the Royal National Lifeboat Institution went out 579 times to the aid of ships in distress, and rescued 427 lives. The past two years, it is reported, have been the busiest which the lifeboat service has had in peacetime.

U.S. TRANSPORT AIRCRAFT FOR CHINA.—The United States War Assets Administration announced recently that China has purchased 150 surplus C-46 "Commando type" transport aircraft. It is stated that considerable reconditioning work will be required before these aircraft can be flown to China.

K.L.M. DUTCH AIRLINES.—In a review of activities during 1947, K.L.M. Royal Dutch Airlines record that a new engine workshop was opened at Schiphol, and a new airport terminal building was completed at Hato, the airport of Curaao. The air fleet was increased during the year by the delivery of fourteen Douglas "DC-3" aircraft, two "L-49" Constellations, and eleven "L-749" Constellations.

TIMBER FOR NAVAL AND MERCANTILE MARINE REQUIREMENTS.—As from January 1, 1948, The Board of Trade states that the grant of licences to acquire or consume timber in naval and merchant shipbuilding and repair work is now undertaken by the Admiralty, and the arrangements under which Denny, Mott and Dickson, Ltd., and John H. Ashton, Ltd., have acted as Admiralty timber agents were terminated on December 31, 1947. All concerned are being informed of the revised procedure for addressing applications for licences (Form T.C.3/8/CPL), but in any case of doubt telephone enquiry may be made as follows: *Timber for Naval requirements*, to BATH Tennyson 1000, Ext. 1045 (Office of the Secretary of the Admiralty, P. Branch 1); *Mercantile Marine requirements*, to WHItehall 3140, Ext. 4 (office of the Director of Merchant Shipbuilding and Repairs) or to the Principal Licensing Officer in the Area in which the requirement arises.

Miscellanea

LEAD SHEET AND PIPE.—The selling prices of lead sheet and pipe have been reduced by £2 per ton as from January 1, 1948. This has been agreed between the Ministry of Works and the Lead Sheet and Pipe Manufacturers' Federation, following the suspension of imports of lead sheet.

THE TIN POSITION.—The Ministry of Supply states that its stocks of tin metal on November 30, 1947, totalled 6326 tons, and that stocks held by consumers were 2798 tons. Consumption in November was 2512 tons. The United Kingdom stock of tin ore on November 30th amounted to 6792 tons.

INSTITUTE OF FUEL.—It will be recalled that in April last, consequent upon its move to 18, Devonshire Street, London, W.1, the Institute of Fuel launched a Building Fund Appeal with the object of raising £25,000. The Institute has now announced that the total contributions received towards the fund by the end of 1947 amounted to more than £18,500.

THE LATE MR. W. J. WOODCOCK.—We have learned with regret of the death of Mr. W. J. Woodcock, which occurred on January 1st. He was a director of the John Bull Rubber Co., Ltd., with which he had been associated for the past eighteen years. Mr. Woodcock was also a member of the National Joint Industrial Council of the Rubber Industry.

BRITISH RAILWAY RECEIPTS.—In the fifty-two weeks ended December 28, 1947, traffic receipts of Britain's four main-line railway companies and of the London Passenger Transport Board totalled £350,403,000, which was £5,364,000 below the 1946 total. In the four weeks ended December 28th, receipts were £28,827,000, compared with £29,143,000 in the four-week period ended November 30, 1947.

AMERICAN STEEL PRODUCTION.—According to the American Iron and Steel Institute, steel production in the U.S.A. during November last amounted to 7,249,523 net tons, bringing the total output during the first eleven months of 1947 up to 77,434,423 net tons. This was approximately 25,000,000 tons above the total steel output of 1939, and nearly 11,000,000 tons higher than the total for the whole of 1946.

EXTENSION OF UNEMPLOYMENT BENEFIT.—Extension of unemployment benefit to people who have exhausted their rights under the National Insurance Act, 1946, is being considered by the National Insurance Advisory Committee. Draft regulations authorising the Minister of National Insurance for five years, after the beginning of the new scheme, to continue the payment of unemployment benefit to such people on the recommendation of a local tribunal are now before the committee, which will consider written objections to these regulations—the Extension of Unemployment Benefit Regulations, 1948—sent before February 3rd, to the Secretary, National Insurance Advisory Committee, London, W.1.

THE LATE MR. J. RANKIN.—We have noted with regret the death, on December 24, 1947, of Mr. James Rankin, works superintendent of the Crewe locomotive works, London Midland Region of British Railways. Mr. Rankin, who was fifty-two, served his apprenticeship with Andrew Barclay, Sons and Co., Ltd., Kilmarnock, and entered the service of the Midland Railway Company at Derby in 1922. He went to Crewe as assistant to the works superintendent in 1932, and in 1939 became acting works superintendent at the L.M.S. Derby works. He was appointed works superintendent at Crewe early in 1946. Mr. Rankin was a Member of the Institution of Mechanical Engineers, the Institution of Locomotive Engineers, and the Institution of Production Engineers.

A GOLDEN JUBILEE.—The golden jubilee of Crawford and Co. (Tottenham), Ltd., collet manufacturers, has recently been celebrated by a party attended by more than 200, including directors, staff and employees, and guests representative of the machine tool industry. The firm was founded in 1897 by the late Mr. Herbert Charles Linzell, in an upstairs room of a small factory at Tottenham, London. As it has developed, it has concentrated almost entirely upon the making of collets and, in 1940, transferred to Tower Hill Works, Witney. Referring to these developments in a speech at the party, Mr. Cecil Linzell, joint managing director, said that since the move to Witney, the firm had progressed with ever-increasing momentum and in less than twelve months from the date of moving increased its output three times with only twice the staff.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

Monday, Jan. 19th.—CENTRAL LONDON BRANCH: St. Ermin's Hotel, Caxton Street, S.W.1. "Some Principles of Construction and Distribution in Rural Areas," K. L. May and T. E. Richings. 6.40 p.m.

Tuesday, Jan. 20th.—Lighting Service Bureau, 2, Savoy Hill, W.C.2. "Foreign Electrical Engineering Practice," C. W. Marshall. 6.15 p.m.

Wednesday, Jan. 21st.—Houldsworth Hall, 90, Deansgate, Manchester, 3. "The Electricity Act, 1947," H. Nimmo. 7 p.m.—COVENTRY BRANCH: Technical College, The Butts, Coventry. "Single to Three-Phase Conversion," A. N. D. Kerr. 7.30 p.m.

Bradford Engineering Society

Monday, Jan. 19th.—Technical College, Bradford. "History and Development of the Diesel Engine," J. Whitaker. 7.15 p.m.

Chemical Engineering Group

Tuesday, Jan. 20th.—Geological Society, Burlington House, Piccadilly, W.1. "Abrasion, Erosion and Corrosion," C. H. Desch. 5.30 p.m.

Illuminating Engineering Society

To-day, Jan. 16th.—BIRMINGHAM CENTRE: Imperial Hotel, Temple Street, Birmingham. "Recent Applications of High Speed Flash Discharge Tubes," C. R. Bicknell. 6 p.m.

Incorporated Plant Engineers

Wednesday, Jan. 21st.—WESTERN CENTRE: Grand Hotel, Bristol. Annual General Meeting. 7.15 p.m.

Thursday, Jan. 22nd.—SHEFFIELD BRANCH: Grand Hotel, Sheffield. Annual General Meeting. 7.30 p.m.

Institute of British Foundrymen

To-day, Jan. 16th.—MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. Film on "The Production of High Quality Steel," presented by W. H. Salmon. 7 p.m.

Institute of Economic Engineering

To-day, Jan. 16th.—Cowdray Hall, Henrietta Place, W.1. Annual General Meeting. 7.15 p.m.

Institute of Industrial Administration

Wednesday, Jan. 21st.—BIRMINGHAM CENTRE: Grand Hotel, Birmingham. "Some Aspects of the Work of the Ministry of Labour and National Service," H. S. Gosney. 6 p.m.

Institute of Marine Engineers

Thursday, Jan. 22nd.—JUNIOR SECTION: Wandsworth Technical Institute, Wandsworth High Street, S.W.18. "Modern Power Station Plant," S. B. Jackson. 7 p.m.

Institute of Metals

Friday, Jan. 23rd.—SHEFFIELD SECTION: Royal Victoria Hotel, Sheffield. "Some Metallurgical Problems in the Field of Atomic Energy," E. W. Colbeck. 6.15 p.m.

Institute of Navigation

To-day, Jan. 16th.—Royal United Services Institution, Whitehall, S.W.1. "Grid Navigation and its Allied Problems," R. H. Blackmore. 5.30 p.m.

Institute of Refrigeration

Tuesday, Jan. 20th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1. Discussion on "Constructional Methods in Insulation." 5.30 p.m.

Institute of Road Transport Engineers

To-day, Jan. 16th.—MIDLANDS CENTRE: Chamber of Commerce, 95, New Street, Birmingham. "Tyres and Steering Geometry," J. H. Hardman. 7.15 p.m.

Institute of Transport

Monday, Jan. 19th.—Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. "Living with Transport," C. Barman and M. G. Bennett. 5.30 p.m.

Institute of Welding

Monday, Jan. 19th.—NORTH LONDON BRANCH: Manson House, 26, Portland Place, W.1. "The Welding of Bridges and Buildings," S. M. Reisser. 7.30 p.m.

Institution of Civil Engineers

Tuesday, Jan. 20th.—Great George Street, S.W.1. Symposium of Papers on "Winter Conditions and the Civil Engineer," Roads, Stanley Mehew; Railways, W. K. Wallace; Municipal, H. J. B. Manzoni; Drainage and Inland Navigation, Ben Howorth; Meteorology, David Brunt. 5.30 p.m.

Wednesday, Jan. 21st.—YORKSHIRE ASSOCIATION: The University, University Road, Leeds. "Pre-Stressed, Pre-Cast Reinforced Concrete," Kurt Billig. 7 p.m.

Institution of Electrical Engineers

To-day, Jan. 16th.—MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. "Survey of Metering Practice in the British Grid System," F. Byrne. 5.30 p.m.

Saturday, Jan. 17th.—NORTH MIDLAND STUDENTS SECTION: Electricity Department, Whitehall Road, Leeds, 1. Main Centre Chairman's Address, E. S. Ritter. 2.30 p.m.

Tuesday, Jan. 20th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2. Discussion on "To What Extent Does Distortion Really Matter in the Transmission of Speech and Music?" Opened by P. P. Eckersley. 5.30 p.m.

Wednesday, Jan. 21st.—TRANSMISSION SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Lightning Surge-Strength of Power Transformers," E. T. Norris. 5.30 p.m.

Thursday, Jan. 22nd.—INSTALLATIONS SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Design of Contactors with Regard to Their Industrial Application," B. Feldbauer. 5.30 p.m.

Friday, Jan. 23rd.—N. E. STUDENTS SECTION: Grey Hall, King's College, Newcastle upon Tyne. "H.V. Oscillograph," W. K. Harrison. 7 p.m.

Institution of Heating and Ventilating Engineers

Tuesday, Jan. 20th.—Institution of Mining and Mechanical Engineers, Neville Hall, Newcastle upon Tyne. "Kitchen Equipment in Industrial Canteens." 6.30 p.m.

Wednesday, Jan. 21st.—LONDON AND DISTRICT ASSOCIATE MEMBERS AND GRADUATES SECTION: Gas Industry House, 1, Grosvenor Place, S.W.1. "Refrigeration," E. A. Friday. 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 16th.—Storey's Gate, St. James's Park, S.W.1. "The Screen in Relation to Engineering Training," H. R. Hockley. 5.30 p.m.

Saturday, Jan. 17th.—N.E. BRANCH, GRADUATES SECTION: Newcastle upon Tyne and Gateshead Gas Company, Grainger Street, Newcastle upon Tyne. "Oil Refining," E. Marshall. 2.30 p.m.

Monday, Jan. 19th.—SCOTTISH CENTRE AUTOMOBILE DIVISION: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow. Chairman's Address, G. T. Smith-Clarke. 7.30 p.m.

Tuesday, Jan. 20th.—LUTON, AUTOMOBILE DIVISION: George Hotel, Luton. "Problems Encountered by the Royal Electrical and Mechanical Engineers in the Field," Major-General Sir E. Bertram Rowcroft. 6.30 p.m.

Thursday, Jan. 22nd.—SOUTHERN BRANCH, GRADUATES SECTION: R. A. E. Technical College, Farnborough. Informal Discussion on "Aerodynamic Research Applied to the Gas Turbine." 7 p.m.

Friday, Jan. 23rd.—Storey's Gate, St. James's Park, S.W.1. "Gas Turbine and Marine Propulsion," T. A. Crowe. 5.30 p.m.—EAST MIDLANDS BRANCH: Nottingham and District Technical College, Shakespear Street, Nottingham. "Problems Encountered by the Royal Electrical and Mechanical Engineers in the Field," Major-General Sir E. Bertram Rowcroft. 7 p.m.

Institution of Production Engineers

To-day, Jan. 16th.—EASTERN COUNTIES SECTION: Electric House, Ipswich. "Preventive Maintenance of Machine Tools," F. H. Ward. 7.45 p.m.

Saturday, Jan. 17th.—YORKSHIRE GRADUATE SECTION: Great Northern Hotel, Leeds. "Diesel Rail Traction," R. E. Ketley. 2.30 p.m.

Wednesday, Jan. 21st.—WOLVERHAMPTON SECTION: Wisemore Schools, Walsall. "Production of Fine Surface Finishes," H. W. Lawton. 7 p.m.—BIRMINGHAM SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Developments in Induction Heating," E. May. 7 p.m.—WESTERN SECTION: Grand Hotel, Bristol. "Various Aspects of Inspection of Production," F. Nourse. 7.15 p.m.

Thursday, Jan. 22nd.—HALIFAX GRADUATE SECTION: Technical College, Huddersfield. "The Training of Apprentices," W. Pilkington. 7 p.m.

Institution of Structural Engineers

Wednesday, Jan. 21st.—YORKSHIRE BRANCH: Great Northern Hotel, Leeds. "Structural Precast Reinforced Concrete," Kurt Billig. 6.30 p.m.

Thursday, Jan. 22nd.—11, Upper Belgrave Street, S.W.1. "The Design of Structures in Areas Subjected to Mining Subsidence," K. W. Mautner. 5.55 p.m.

Friday, Jan. 23rd.—MIDLAND COUNTIES BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham. "Some Practical Considerations in Design of Welded Structures," R. G. Braithwaite. 6 p.m.

Junior Institution of Engineers

Friday, Jan. 23rd.—39, Victoria Street, S.W.1. "Trade Marks," Geoffrey W. Tookey. 6.30 p.m.—SOUTH MIDLAND GROUP OF MEMBERS: Technical College, Park Square, Luton. "Submersible Pumps and Motors, Their Construction and Applications," W. L. Gardiner. 7.30 p.m.

Manchester Association of Engineers

Friday, Jan. 23rd.—Engineers' Club, Albert Square, Manchester. "Developments in Shot Blasting," R. Ankers. 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Jan. 23rd.—Mining Institute, Newcastle upon Tyne. "Classification Societies and the Efficiency of Hull Structures," J. L. Adam. 6.15 p.m.

North Western Fuel Luncheon Club

Wednesday, Jan. 21st.—Engineers' Club, Albert Square, Manchester. "One Year of Nationalisation," Arthur L. Horner. 12 noon.

Rugby Engineering Society

Wednesday, Jan. 21st.—Corporation Electricity Department, Rugby. "Marine Engineering, Present and Prospective Practice," H. Hunter. 7.30 p.m.

Society of Engineers

Tuesday, Jan. 20th.—INFORMAL SECTION: 17, Victoria Street, S.W.1. "Meteorology," F. W. M. Ruck. 6.30 p.m.

Women's Engineering Society

Tuesday, Jan. 20th.—Engineers' Club, Albert Square, Manchester. "Electrical Measurements," B. W. Lambert. 6.30 p.m.

Personal and Business

MR. R. J. TURTON has been appointed general service manager of Mackay Industrial Equipment, Ltd.

MR. L. W. PHILLIPS, M.I.E.E., has been appointed technical editor to Macdonald and Co, (Publishers), Ltd.

MR. S. A. SHINGLER, A.M.I.Mech.E., has been appointed chief engineer of the Scindia Steam Navigation Company, Ltd., Bombay.

G. AND J. WEIR, LTD., announces the retirement of Mr. R. M. Gillies, London manager for the past twenty-nine years. Mr. Andrew C. Smith has been appointed to succeed him.

MR. ERNEST SOUCHOTTE, M.I.Mar.E., Superintendent Engineer of Alfred Holt and Co., has been appointed to the engineering staff of Harland and Wolff, Ltd., Belfast.

MR. S. FERGUSON has relinquished his appointment as managing director of Cooke and Ferguson, Ltd., but will continue to serve as chairman of the company. Mr. J. R. Ferguson has been appointed general manager.

MR. H. L. PHILLIPS has been appointed assistant export manager of the Nordberg Manufacturing Company, Milwaukee, U.S.A. The company's London office, at Brook House, Park Lane, W.1, will continue to deal with overseas business under the direction of Mr. G. J. Brown.

THE COLONIAL OFFICE announces the following appointments: Mr. G. R. S. Paskins, assistant engineer, railways, Tanganyika; Mr. H. W. McAughtry, assistant engineer, Ways and Works Department, Malayan Railway; and Captain N. L. Mitchell, executive engineer, Public Works Department, Nigeria.

THE VULCAN FOUNDRY, LTD., which has held an interest in Robert Stephenson and Hawthorns, Ltd., since 1943, announces that its stock holding now exceeds one half of that company's equity capital, and Robert Stephenson and Hawthorns, Ltd., is thereby constituted a subsidiary of the Vulcan Foundry, Ltd.

THE TRIPLEX SAFETY GLASS CO., LTD., has appointed five of its employees to the board of directors. They are Mr. H. W. Baker, Mr. C. L. Cripps, Mr. J. W. Follett, Mr. A. G. Rose and Dr. A. C. Waine. Mr. Arthur Cochrane, who has been a director since 1935, has been appointed assistant managing director.

THE MINISTRY OF TOWN AND COUNTRY PLANNING announces that Mr. Gordon Stephenson, M.C.P., F.R.I.B.A., has resigned his appointment as Chief Planning Officer (Planning Technique), on his appointment to the Chair of Civic Design at Liverpool University. Mr. R. T. Kennedy, A.R.I.B.A., A.M.T.P.I., has been promoted Chief Planning Officer (Acting).

MR. C. T. GARDNER is relinquishing his appointment as Deputy Director of Canals in the Ministry of Transport consequent upon changes brought about by the nationalisation of inland waterways. Mr. Gardner has also acted as assessor to the Ministry on the Water Pollution Research Board and joint assessor to the recently appointed Hydraulics Research Board.

Reports on German and Japanese Industry

Limited numbers of copies of the reports of Intelligence Objectives Sub-Committees on German and Japanese Industry listed below can be obtained from H.M. Stationery Office at the prices stated.

No. of report.	Title.	Post free. s.	d.
	B.I.O.S.:		
	Technical Index (Part 2): August, September and October, 1946, Supplement to the above Index	1	7
	Technical Index (Part 3): November and December, 1946, Supplement to the above Index... ...	1	7
1269	Test Gear for Frequency Modulation and Television	3	8
1470	The Lay-out of Chemical Factories	18	5
1501	Aspects of Industrial Medicine and Hygiene in German Chemical Factories	7	9
1522	Methyl Cellulose Production at Kalle and Co., Wiesbaden-Biebrich	8	3
1538	A Review of Some of the German Textile Leather Producing Firms	8	3

Technical Information and Documents Unit, German Division, Board of Trade, 40, Cadogan Square, S.W.1, which has at its disposal a considerable volume of information not in a form suitable for general reproduction, is prepared to receive enquiries regarding all problems relating to scientific and technical intelligence on both German and Japanese industry.

A Seven-Day Journal

Lloyd's Register Shipbuilding Returns

THE quarterly statistics issued by Lloyd's Register of Shipping regarding merchant vessels under construction at the end of December last show that in Great Britain and Northern Ireland there was an increase of 60,692 tons in the work in hand compared with the figures for the preceding quarter. The present total of 2,173,361 tons gross is greater by 236,299 tons than the tonnage which was being built at the end of 1946, and has not been exceeded since March, 1922. It is pointed out, however, that the continued increase in the tonnage of vessels under construction is necessarily influenced by the delays which present circumstances are imposing upon the completion of ships and the consequent prolongation of the time required for building them. At the end of December shipbuilding work which was suspended amounted to 1200 tons. The returns indicate that there is a continued increase in the tonnage intended for registration abroad or for sale. This figure has risen progressively from 105,000 tons at the end of March, 1946, to 671,000 tons at the end of December, 1947, which total represents 30·9 per cent of the tonnage being built in this country, and includes fifty-one vessels, aggregating 146,832 tons, on which construction was begun during the final quarter of last year. The tonnage of merchant shipping under construction abroad at the end of December was returned as 1,808,996 gross tons, but it should be noted that no figures have been included for Germany, Japan and Russia. The total amount of merchant shipping under construction in the world—apart from those countries mentioned above—is 3,982,357 gross tons, of which 54·57 per cent is being built in the United Kingdom and 45·43 per cent abroad. Of the total under construction in the United Kingdom at the end of December, 980,507 tons consisted of steamers, and 1,182,475 tons consisted of motor ships, the tonnage being constructed abroad comprising 462,139 tons of steamers and 1,346,857 tons of motorships. Another point mentioned in the returns is that, of the merchant shipbuilding in hand throughout the world at the end of December, 2,551,708 tons—more than 64 per cent—were being built under the inspection of Lloyd's Register.

Scientific Research in Northern Ireland

THE Northern Ireland Government has announced the formation, by its Ministry of Commerce, of a Council of Scientific Research and Development. The work of the Council, it is stated, is to be closely linked with that of the Directorate of Scientific Development of the Ministry of Commerce, and will be carried out under the following terms of reference: to advise the Ministry of Commerce on all scientific questions connected with the utilisation and development of the natural resources of Northern Ireland; to promote the increased application by industry of the latest discoveries and developments in the fields of pure and applied science with the object of improving present industrial methods and processes, creating new industries and expanding existing ones; to arrange for such investigations and research work as the Council may consider desirable in the best interests of Northern Ireland; and to promote the wider dissemination of scientific knowledge throughout Northern Ireland. Sir David Lindsay Keir, LL.D., has been appointed chairman of the Council, the other members of which are Mr. D. H. Alexander, M.Sc.; Professor R. G. Baskett, M.Sc.; Mr. O. F. Brown (of the D.S.I.R.); Mr. H. Bryson; Professor J. K. Charlesworth; D.Sc.; Mr. M. Eitel; Professor K. G. E. Emeleus, Ph.D.; Professor D. C. Harrison, D.Sc.; Mr. A. J. Howard, A.R.I.C.; Professor K. S. Isles, M.Sc.; Mr. B. McCance; Mr. D. Rebbeck, M.Sc.; Dr. A. J. Turner; Mr. R. C. Wilson; Mr. D. E. Wiseman, and Professor A. R. Ubbelohde, D.Sc. Addressing the first meeting of the Council last week, Sir Roland Nugent, Minister of Commerce in Northern Ireland, spoke of the necessity to create an organisation which would derive the greatest possible benefit from scientific activities carried out in the United Kingdom and overseas, and one which would supplement, if required, those activities by initiating researches on subjects of immediate local interest which could not be investigated elsewhere.

Institution of Electrical Engineers

THE Council of the Institution of Electrical Engineers announces the election of two new Honorary Members of the Institution and the award of the Faraday Medal. Colonel Sir Thomas Purves is made an Honorary Member for his distinguished work in electrical engineering and for his services to the Institution. Sir Thomas's name is closely associated with telecommunications and he was Engineer-in-Chief of the G.P.O. from 1922 to 1932. His many services to the Institution culminated in his election as President in 1929. Admiral of the Fleet Sir John Cunningham, First Sea Lord and Chief of the Naval Staff, becomes an Honorary Member in recognition of his outstanding efforts to stimulate the application of electrical techniques in the Royal Navy. It will be recalled that Admiral Cunningham was Fourth Sea Lord during the critical period from April, 1941, to May, 1943, and that in October, 1943, he became Commander-in-Chief Mediterranean. The twenty-sixth award of the Faraday Medal is made to Professor M. L. E. Oliphant, F.R.S., for his distinguished work in nuclear physics and his discoveries in the physical sciences—notably in the production, study, and use of electromagnetic oscillations. In 1937 Professor Oliphant became Poynting Professor of Physics at the University of Birmingham. He was awarded the Hughes Medal of the Royal Society in 1946, after which he was elected as an Honorary Member of the New York Academy of Sciences.

N.E. Coast Institution's Research Scholarships

THE North East Coast Institution of Engineers and Shipbuilders has announced that two post-graduate scholarships of £500 each will be available for award during the next three years, and thereafter the Council will review the question of awarding further scholarships. The object of these scholarships is to encourage research work which shall preferably be carried out on the North East Coast. The first of these scholarships is to be made available, should a suitable candidate present himself, for use in the Autumn of this year, and will be awarded in the form of two annual payments of £250. It is explained that the research scholar will be permitted to hold the scholarship, along with other financial grants, and candidates are required to have the following qualifications: they must be British subjects and members of the Institution prior to application for the scholarship; they must be graduates of the University of Durham or associated with an engineering, shipbuilding or ship-repairing works on the North East Coast; and they must be recommended for the award of the Scholarship by the head of the department in which they obtained their degrees or the head of the department where they propose to carry out their research. There is no age limit for candidature, and holders of the scholarships will be expected, in due course, to present the result of their research work to the Institution in a form suitable for publication in its "Transactions." The Institution adds that no final date for the receipt of applications for this year's scholarship has yet been fixed, but it may be accepted that it will be about July, 1948, following the announcement of the results of degree examinations.

Littlebrook "B" Power Station

To illustrate some aspects of the Ministry of Supply's work in smoothing the progressing and production of power station plant, the London Regional Controller of the Ministry accompanied a party of Trade Union officials on a vist to the Kent Electric Power Company's Littlebrook power station, near Dartford, on Monday, January 19th. After a rapid tour of the existing station, Littlebrook "A," the party was shown the main building of station "B," which is under construction. Commissioned in the early part of the war, Littlebrook "A" station has two 30MW and one 60MW turbo alternator sets. This generating capacity will be doubled when station "B," with its two 60MW, 3000 r.p.m., 11·8kV hydrogen-cooled sets is completed, probably in the spring of 1949. A further increase of 240MW is envisaged at the projected "C" station, and directions have already been received for two of the four 60MW sets. It is stated that the site occupied by these stations is capable of development to an ultimate capacity of about 1000 MW. At Littlebrook "B" construction has now reached the stage at turbine floor level, when the first foundation block will shortly be ready to receive its turbo alternator, which it is hoped, will be in commission for the winter of 1948/49. The two pulverised fuel boilers are designed for 1350 lb per square inch pressure and 850 deg. Fah., and an interesting point about the steam conditions is the use of reheating between the h.p. and i.p. stages of the turbine. The building shell and chimney are of reinforced concrete construction throughout. Messrs. Merz and McLellan are the consulting engineers for the project, with Sir Alexander Gibb and Partners as consultants for the civil engineering work.

The Royal Mail Liner "Andes"

ON Tuesday, January 20th, a party of guests was invited to inspect, at Southampton, the reconditioned Royal Mail Lines' passenger liner "Andes," which, after a very successful career in the war, resumed her place in the South American service of her owners on Thursday, January 22nd. She was completed by Harland and Wolff, Ltd., at Belfast, in September, 1939, and was to have sailed on September 26th of that year, when she would have celebrated the centenary of her owners. Instead she was able to fulfil an important mission as a troop transport ship. We hope to refer in more detail to her outstanding services and technical equipment in a later article. The guests were welcomed by Mr. Walter C. Warwick, the chairman of Royal Mail Lines, Ltd., and Mr. George Barnes, the Minister of Transport, replied. He welcomed this new link with the Latin-American countries and was impressed by the provision the owners had made for the comfort and welfare of the crew. The "Andes" has an overall length of 669ft 3in, a moulded breadth of 83ft, and a loaded draught of 29ft 3in. Her gross tonnage is approximately 25,700, and her service speed 21½ knots. On trials she attained about 23 knots. She is designed to carry 324 first-class and 204 second-class passengers, who are excellently accommodated in outside cabins and have large and pleasing public rooms. The propelling machinery comprises a twin-screw arrangement of Parsons geared turbines, taking steam from three Babcock-Johnson water-tube boilers. The total shaft horsepower developed is about 30,000. In addition to the main boilers, there is an auxiliary boiler and the electrical generating plant is grouped in a special engine-room. The latter consists of three Fraser and Chalmers turbines driving G.E.C. generators through Power Plant gears and in the wings are two sets of British Polar oil engine-driven generating sets, which are used only for port service. At sea all machinery is steam-driven.

The British Engineer in India:

HIS MONUMENT—THE FUTURE

By Sir STANLEY REED, K.B.E., LL.D., M.P.*

No. I

WE of this generation have been participants in one of the greatest events in the history of the human race—the transfer of responsibility for the good government of 400 millions of people, exercised with wisdom and integrity, notwithstanding inevitable mistakes, to the incalculable benefit of the Indian races, for a century and a half. Already some of the immense results of this tremendous change are apparent. The unity of India, a unity under which the King's writ ran unchallenged from Cape Comorin to Peshawar, from Karachi to Mandalay, has been shattered. India has been divided into three units: Eastern and Western Pakistan, separated by near a thousand miles, Moslem in character; and India, predominantly Hindu; whilst Burma already has her independence, and none can say where the process of fission will end. Lord Louis Mountbatten will be the last of the Viceroys. The Indian Civil Service is a thing of the past. The imagination boggles at the magnitude of the changes which have already followed, illustrated by the mass migration of 7 millions of Hindus from Pakistan to India, of Moslems from India to Pakistan, with the bloodshed, disease and misery this colossal movement has entailed. Where will it end?

Many voices have sung pæans of the great ones of the past. Of the Viceroys and Governor-Generals — Hastings, Wellesley, Dalhousie, Curzon and Hardinge. Of the Governors who have left their mark on provinces larger than most of the European States—Lawrence, Macdonnell, Elphinstone and Lloyd. Of the Indian Civil Service, rarely more than a thousand strong, the cream of our universities, who represented the Raj, as heads of the districts, to the common folk. The ancillary services—public works, forests, medical—whose work is done. What monuments will they leave? The stately homes of the Viceroys in Calcutta and New Delhi—to what uses will they be put? The portraits which hang on these walls, the statues which adorn the public places, how long will they hang or stand? Whatever passes, the work of the engineer will remain as long as there is any Government in India. I sing the song of "The Engineer." Whatever may pass, their handiwork will remain, an enduring monument to the imagination, skill and courage with which they brought water to the parched fields, the transport which distributed the abounding produce of long desert lands to a hungry people increasing at the rate of 5 millions a year, to the ports for shipment abroad.

Would that this grateful task were entrusted to competent hands. I am not an engineer, but perhaps the engineer would screen the dramatic factor under cusecs and masonry masses, as prodigious, perhaps as unmeaning, as the figures in a Dalton Budget. My excuse is just this. Amongst my most vivid memories of fifty years' association with India are those of the appalling consequences of famine. Arriving when the failure of the rains in 1896 were passing, and seeing the consequences in the Bombay Deccan, I can recall the agony with which we watched the feeble monsoon current in August and September of 1899, asking day in, day out, whether the indraught of the rain-bearing currents from the south-west would be strong enough to moisten the sun-baked fields of Western and Central India, of Rajputana and the Punjab. When they failed, I spent toilsome months in the stricken areas, and perhaps two experiences will drive the lesson home. In the small town of Udaipur, capital of the Rajput State of that name, the cholera deaths were 400 a day. In one of the lesser districts of Gujarat, when the epidemic swept like a tornado across the relief works, 1500 dead were burnt in three days. Then when the rains came, malaria spread like a plague over a people worn by strain and hunger until they died in myriads. With this acid experience, such time as I could spare from the wrangle of politics I passed amongst the engineers. Standing at the headworks of the Lower Chenab Canal at Khanki and steaming for hours amid the lush wheatfields of the Punjab between Wazirabad and Multan—the flow of the Chenab at Khanki is six times that of the Thames at Teddington—or spending happy days with the men who saved the Bombay Deccan from periodic scarcity my heart has sung with gratitude to these wise and courageous compatriots; their work is good and will endure.

The British engineer in India, however, had one defect; like Lord Roberts, he did not advertise. Of a thousand of our people who know something of the Aswan dam, and of Great Boulder, Grand Coulee and Muscle Shoals, who has any concept of the Sukkur Barrage, which, controlling and distributing the waters of the mighty Indus, brought under irrigation an area as large as the whole irrigated area of Egypt? Of the Bhatgar dam on the Nira, which contains more masonry than the Aswan? Of the imagination which turned the flow of the Periyar from its natural outlet into the Arabian Sea, where it was wasted, eastward into the Bay of Bengal, fertilising a huge area on its new course? Most striking of all, the insight of Wilson and Jacob, who planned to bring the surplus waters of the Jhelum across river and canal to the Lower Bari Doab? Perhaps another reminiscence will be forgiven. When I was directing the Government of India's 1914-18 war publicity, the Minister in charge of Public Works sent me the outline of the irrigation report—then a dreary assembly of the most arid statistics—in a new form and asked my advice. It was uncompromising; the new form embodied every possible defect; what was needed was a graphic description of the great works and their history in handy book form, which should be revised at intervals of three or five years, the statistics being published annually. For once seed did not fall on stony secretariat ground; the right penman was found in D. G. Harris, and an arresting history of Indian irrigation was published in 1923 by the Oxford University Press. If there is a later edition it is not to be found and a single well-worn copy was disinterred from the library of the India Office.

It is an entrancing story. Before settled government was established the engineers got to work. Naturally, they first turned attention to such remains of past enterprise as they found. Cotton remodelled the Grand Anicut on the Cauvery in Madras, and so demonstrated what could be done by modern skill. The Jumna was taken in hand; that river was first tapped in the fourteenth century, to bring water to the emperor's hunting lodge, and in 1568 by Akbar to meet the needs of imperial Delhi. It had fallen into decay until remodelled and extended; by 1873 it had been raised to the status of a major work. If some of the many who, visiting Delhi, wander round the monuments of the Moghul sovereigns—Humayun's tomb, the Kutb Minar and the Purana Kila—or gaze in admiration at Lutyen's Viceroy's House, would spend an hour in visiting the adjacent headworks of the Jumna Canal, they would see whence the abounding crops they have observed on the last stage of their railway journey from Muttra to Delhi derive their lifeblood, and win at least a nodding acquaintance with the irrigation engineer. Pre-eminent in these early enterprises was that of Probyn Cautley on the Ganges Canal, the first entirely new and big scheme taken in hand. Undeterred by war, pestilence and shortage of funds, Cautley and his colleagues pushed this through and it was finished in 1862. Even after the lapse of nearly a century this may still be classed amongst the greatest feats of irrigation engineering in India; the Solani aqueduct of fifteen arches, each with a 50ft span, stands as one of the most magnificent irrigation works ever constructed. Until recently, at any event, there remained on the canal a modest dwelling, known as "Willcocks' Bungalow." This was the abode of the father of those three remarkable men—William, whose dynamic energy made the construction of the Aswan Dam against every conceivable obstruction possible. James, the soldier; Ernest, of the Public Works. India can peculiarly claim William, for he got his training at Rurkee; Ernest was a Cooper's Hill man, and had as his bent architecture. Of course, serving in India, after one satisfactory building, the Anjuman-i-Islam Institute in Bombay, he was always otherwise employed, but he found one last opportunity when supervising the new broad-gauge route from Bombay to Delhi in the happy design of the stations on the Nagda-Muttra line.

Another digression—if it be permitted. Voyaging from Basra to Karachi, I had as fellow-passenger, William Willcocks, returning from his preliminary survey of the irrigation possibilities in Mesopotamia. His eyes kindled as he said: "From any vantage point the whole of the early system of works is spread like a map before you." That granary of tradition, it is true, perished when the eruption of Ghengiz Khan wrecked the headworks—a legend not without its significance. His eyes kindled again when he described how he found the son of Mughal Bey, the author of the Rosetta Dam which Scott Moncrieff rescued from neglect, incidentally saving the Egyptian Government an annual charge of £200,000 a year for a pumping station, and Mughal Bey himself from obscure poverty—the story is told in Milner's vivid "England in Egypt"—seeking to close a breach in the Euphrates. In that soft, stoneless soil, no ordinary measures suffice to hold a flood; brick towers were erected on either side of the breach; at a given moment blown up so that the mass fell into the gap. Mughal Bey's son had failed. "Build up your towers and try again!" cried Willcocks. "If you fail, try again and again. Oh! to see these waters spreading over the dry and arid land, if it is only for an hour!" Then one realised the irresistible energy which triumphed over all obstructions—the archæologists who denounced the drowning of the temples of Philae, the faint hearts

* Sometime Editor of "*The Times of India*"

and the doubters—and set Egypt still more firmly on the path of the prosperity she ought to be enjoying.

It is well-nigh impossible for us in these more settled days, with an immeasurable improvement in communications, to appreciate the difficulties which beset the early engineers. No Ronald Ross had arisen to denounce the mosquito as the evil factor in malaria; no Haffkine had discovered the anti-cholera prophylactic; these twin dangers were the nightmare of the constructor. Nor had the American engineers, who, raising the levees of the Mississippi, developed the steam shovel and the dragline excavator. Nothing could illustrate this better than conditions in which the Periyar dam was built. The country was uninhabited and covered with dense jungle and the nearest railway was 90 miles distant. Malaria reached appalling proportions and during a single year—1895—the average number of labourers was 2449; the average monthly hospital attendance, 1081. Masons were almost impossible to procure, and, as the historian of the work wrote, "any ambitious cooly who could borrow or steal a pair of old boots and a trowel presented himself unblushingly for the job." Yet, generally speaking, the quality of the masonry was first-class. And the results? It rendered one of the most precarious tracts in Madras practically free from want and 176,000 acres were provided with an unfailing supply of water.

But it must be confessed progress to this stage was spasmodic; indeed, in the 'sixties the untrammelled imagination of Cotton, with the glamour of the Grand Anicut attaching to his name, led to vast projects under joint stock company management and grievous errors, with disastrous consequences to the investors, and the final conclusion that major irrigation works were a matter for Government agency. It remained for Lord Curzon, as one of the twelve tasks he set himself on assuming the Viceroyalty, to create a plan. Curzon used to say to his best of private secretaries, Walter Lawrence, "If we get the wheels on the right track the train will move on." Politically, Curzon forgot that without the energy of public approval the engine might come to a standstill for lack of fuel; in its permanent benefits, none of his activities was more fruitful than the calling of Scott Moncrieff to preside over an Irrigation Commission. It began its inquiries in the nick of time. The Punjab was a paradise for the irrigation engineer. Elsewhere, in the cultivated tracts, the water, when provided, had to be distributed amongst a multitude of petty holdings; the Punjab desert, or Crown waste tracts, as they were called, had no resident population beyond a few nomads who eked out a precarious existence as graziers; the land could be parcelled out into neat rectangles, hand-picked cultivators imported from the congested districts to find everything ready for their labour except building the villages. Some experience of the possibilities of canal colonisation was gleaned from the smallest Lower Sohagmara and Sidhnai canals, and then its tremendous possibilities burst on the administrative world from the astonishing fruits of the Lower Chenab works. These served a tract of extreme desolation. Water lay for the most part from 80ft to 120ft below the surface of the soil, whilst the rainfall was scanty and uncertain. With the exception of snakes and lizards, the country was extraordinarily devoid of animal life; the vegetation consisted of dusty shrubs, grazing there was none, the only inhabitants were hardy nomads. The canal converted this wilderness into a garden and at the peak earned 45 per cent on the capital cost of £3¼ millions.

Naturally, the engineers, like Oliver Twist, asked for more. They looked on the Lower Bari Doab—the country between the Ravi and the Sutlej—and cast covetous eyes on the waters of the Sutlej; a scheme for their use was prepared. Wilson and Jacob protested; this would mean that the surplus waters of the Jhelum could never be utilised, whilst the Sutlej would be wanted for the lands on both sides of that river. They prevailed, and from their foresight and vision sprang one of the most dramatic imaginative schemes in the history of engineering. The Upper Jhelum Canal carries the waters of that river into the Chenab, thus feeding the Lower Chenab Canal; the Chenab water so freed is turned into the Upper Chenab Canal. Then this canal was constructed southwards to the Ravi, which it passed by a level crossing below which it is known as the Lower Bari Doab Canal. John Benton, it is understood, was prepared to cross the Ravi by siphons, but even the daring Punjab engineers boggled at the possibilities of a breakdown and the novel medium of a level crossing was adopted. This triple scheme ranks as one of the biggest works in the world, with 433 miles of main canals and branches, commanding 6250 square miles of land, much of it formerly waste, and for the first time 2500 square miles were brought under the plough. Surely even more striking than these remarkable results is the disciplined imagination which conceived the idea of taking command of the surplus waters in the Jhelum in the north and carrying it over canal and river and watercourses innumerable to the dry lands in the distant south.

What of the waters of the Sutlej, literally snatched from the maw of the Punjab? There the problem was complicated. It aimed at regularising the service of the inundation canals on either side of the river in the Punjab and the Indian State of Bahawalpur and, in addition, a vast area of perennial irrigation. The engineering difficulties were not great, the political serious. How was the water to be allocated between the Punjab and the Indian States of Bikaner and Bahawalpur? To and fro the ball was tossed; my honoured friend, the late Maharajah of Bikaner, looking on his huge desert territory and the fertile lands which needed only water to make them blossom, grew grey with anxiety as the years passed and no solution was found. At last an allocation was agreed, and even then its equities were doubtful; Bahawalpur was awarded more water than it could profitably use and the other partners went short. However, it was done; with four weirs and twelve canals this vied with the triple project in magnitude. This ranks with the greatest major works, commanding nearly 8000 square miles, and what was of even more importance, some 4 million acres of desert waste. The scheme was suggestive, because it introduced the lined canal. The Punjab Government had long looked enviously to the prospect of the lined canal, permitting smaller channels with a high velocity and preventing seepage, and went to the point of participating in the establishment of cement works so as to secure an adequate supply of concrete. It was put into operation in the section functioning in Bikaner State, 90 miles of lined canal, the longest, it is understood, in the world. Accustomed to the vast channels in the Punjab and Sind, some of which make the Suez Canal look small, it was a revelation to stand at the delivery point of the Sutlej in Bikaner and mark the swift-flowing current pouring down its narrow width; so successful was the work that the Maharajah told me if he had known earlier what the results would be all the distributories would have been lined as well. The lining of canals will loom big in the works of the future.

(To be continued)

Naval Construction in 1947

By FRANCIS McMURTRIE, A.I.N.A.

No. IV—*(Continued from page 64, January 16th)*

Turkey

In common with various other countries, Turkey has been endeavouring to renew her fleet by the purchase of war built tonnage. So far such additions have included sixteen American-built minesweepers of the "Auk" type and five others of Australian construction, all of which have been named after Turkish ports. Four motor minesweepers, twenty-three motor launches, and a trio of boom defence vessels have been acquired from the Admiralty, four submarines and three fleet auxiliaries from the U.S. Navy Department, and recently a dozen ex-German räumboote have been added.

Greece

A quantity of British naval tonnage is on loan to the Royal Hellenic Navy, including ten destroyers, six submarines, four corvettes, eight motor minesweepers, seventeen motor launches, a trawler and six landing craft. From the United States the Greeks have acquired two landing ships (dock), three landing ships (tank), six motor gunboats, and an uncertain number of motor minesweepers, amounting possibly to twenty-five. In fact, almost the whole of the fleet is made up of ships derived from Anglo-American aid schemes.

Norway

Norwegian naval development and especially the training programme suffered somewhat in 1947 through the failure, owing to political objection, of a proposal to acquire H.M.S. "Arethusa" on very attractive terms. Otherwise there have been few changes, though the destroyer "Aalesund," of 1220 tons, laid down at Horten in 1939, is understood to be very near completion. The five torpedo boats of the "Sleipner" class, designed a dozen or more years ago, are undergoing extensive alteration, entailing the reduction of the number of boilers from three to two. This will bring the horsepower down to 8300 and lower the maximum speed to about 25 knots.

Denmark

Both the 710-ton destroyers of the 1939 programme, the "Hvitfeldt" and "Willemoes," have been completed. Geared turbines of 21,000 s.h.p. are designed to give them a speed of 35 knots, reported to

have been realised on trials. The armament comprises two 3·5in, two 40mm, and four 20mm guns, with six torpedo tubes.

Nearing completion are six 329-ton torpedo boats, all built, like the above two ships, in the Royal Dockyard at Copenhagen. Though of less than half the displacement, they are almost as heavily armed as the larger vessels, mounting two 3·5in and two 20mm guns and six torpedo tubes, though the latter are of 18in calibre instead of 21in. Geared turbines of 6900 s.h.p. are to give a speed of 29 knots.

To supplement this new flotilla, an ex-German ship, hitherto known as "T 19," has lately been acquired. She is a vessel of 600 tons, propelled by geared turbines of 22,000 s.h.p., and credited with a speed of 33 knots. When in German hands she was armed with one 4·1in, one 40mm, and several smaller anti-aircraft pieces. The torpedo armament is six 21in tubes.

Three submarines of the "U" type are on charter from the Royal Navy pending the refitting of Danish submarines salved after being scuttled in 1943. Only two of the latter are expected to be fit for further service. Eight motor minesweepers of British type are being operated on loan. Other additions to the fleet since the war ended are twenty-two motor minesweepers and ten motor torpedo boats, formerly belonging to the German Navy.

Portugal

Work is in hand at Scotstoun on the refitting and modernisation of the five destroyers of the "Vouga" class, under a joint contract with Yarrow and Co., Ltd., and Vickers-Armstrongs, Ltd.

No other fresh construction is reported from Portugal, though it will be necessary to replace the surveying vessel "Dom Joao de Castro," a fine ship of 1028 tons, completed at Lisbon during the war, and wrecked in the Cape Verde Islands last October.

Belgium

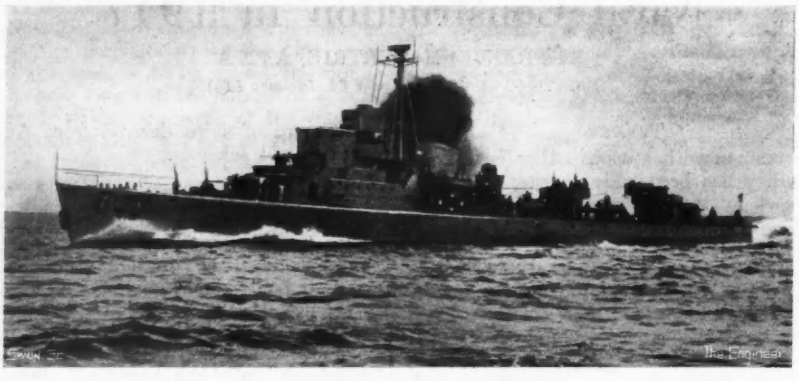
Though the 32-year-old sloop "Zinnia" is practically the only seagoing ship of any size in the small Belgian naval forces, nothing seems yet to have been done towards replacing her. The larger and more modern "Artevelde" remains immobilised, her engines having been sabotaged by the Germans. An ex-American frigate, the "Victor Billiet" (ex-"Sheboygan") has been acquired for use as a weather observation ship, but practically all other naval duties of note have to be undertaken by the antiquated "Zinnia," said to be incapable of steaming above 8 knots. In these circumstances, the alternatives would seem to be either to acquire another ship or to replace the engines of the "Artevelde."

Argentina

No effect seems yet to have been given to the important programme of naval construction authorised by the Argentine Government towards the end of 1946, beyond the purchase of four ex-American frigates. These have been named "Hercules," "Heroina," "Sarandi," and "Trinidad." Two oil tankers and a large tug have also been acquired.

Brazil

To replace the lost "Baia" and her sister ship, the 38-year-old "Rio Grande do Sul," the United States Navy is to present the Brazilian fleet with two discarded cruisers of 10,000 tons, the "Nashville" and "Phœnix." Completed in 1938–39, each mounts fifteen guns of 6in calibre as main armament, and has a nominal speed of 32·5 knots.



Danish Destroyer "Hvitfeldt"

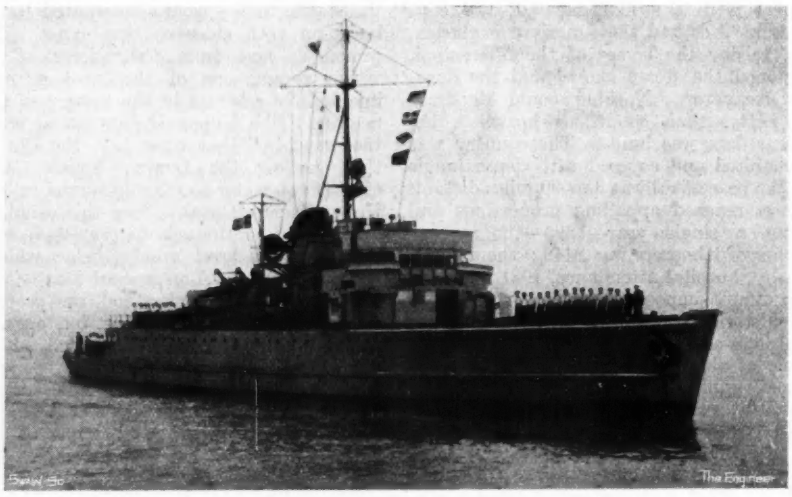
The destroyers "Amazonas" and "Araguaia," launched in 1943, should soon be ready for commissioning.

Chile

From the United States Navy Chile is to receive the 10,000-ton cruiser "Boise," a sister ship of the two that are to go to Brazil. Two transports that were bought towards the end of 1946 have been named "Presidente Errazuriz" and "Presidente Pinto." Other recent acquisitions include three fleet tugs, four landing ships (mechanised) and twenty-two landing craft.

Other Latin-American Republics

In addition to the cruiser "St. Louis," which it is expected to receive as a gift from the United States, Peru has bought two ex-Canadian frigates, an oil tanker and a supply ship. Ecuador has purchased in the U.S.A. one or two frigates; Colombia, a frigate; Mexico, five large patrol vessels of the "PCE" type; and Venezuela a landing ship and four small coast guard cutters.



Belgian Sloop "Zinnia"

China

Full information concerning the numerous warships acquired by China is lacking, though the figures given in these columns a year ago seem likely, if anything, to be exceeded. H.M.S. "Aurora," renamed "Chungking," and H.M.S. "Mendip," renamed "Lin Po," are expected to hoist the Chinese ensign early this year. From the defunct Japanese fleet China has received, as her share in the distribution of prizes, seven destroyers, two minelayers, seventeen escort vessels, two submarine chasers, three minesweepers, six gunboats and three transports. It is obviously impossible to man all these ships at present.

Egypt

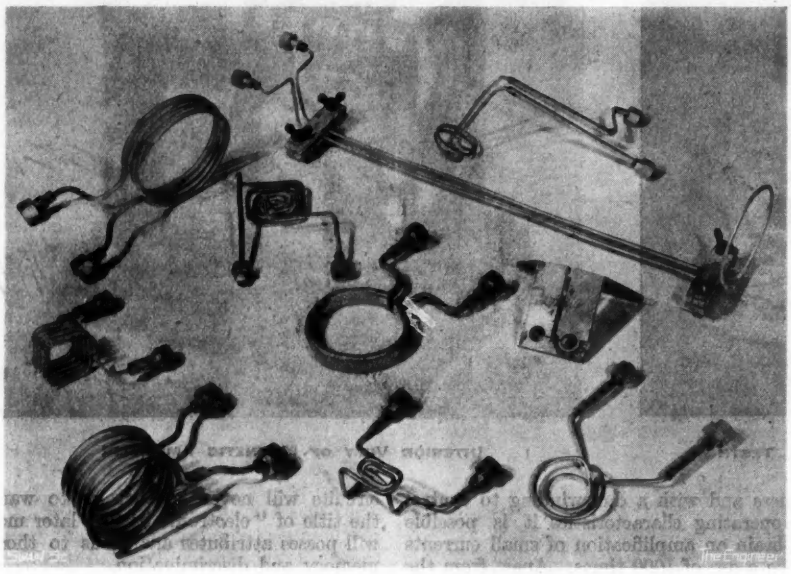
Egyptian naval forces are busy training crews for the commissioning of eight ex-American motor minesweepers, an ex-British motor launch and twenty landing craft, which have been bought during recent months. The motor launch has been named "Hamza," but names have still to be found for the remainder.

British Cast Iron Research Association.—The report of the British Cast Iron Research Association for the year ended June 30, 1947, which has recently been issued, records that the number of enquiries dealt with by the Development Department, including the Scottish laboratory, totalled 1352. It is also stated that the investigational programme of the department has included work on specific problems being experienced by industry, especially in connection with present shortages of raw materials. Two investigations, one concerning rust spotting defects experienced in the light castings industry and the other concerning the use of sand bonded with pitch, are being carried out under the direction of Mr. W. B. Parkes, the assistant manager of the department. Every opportunity was taken during the year to examine possible substitutes for raw materials at present in short supply, such as linseed oil and coal dust.

Electronic Equipment in Industry

By G. PARR, M.I.E.E.*

NOW that electronic apparatus has found an accepted place in industry, its applications are falling into two main classes: those in which it forms an integral part of the production system and those in which special equipment is used for measurement or control of a process which is less adequately done by older methods.



COILS FOR R.F. HEAT TREATMENT OF METAL COMPONENTS

The high-frequency generator is an example of electronic equipment which is becoming indispensable for speeding up the manufacture and treatment of component parts. The fact that non-metallic substances can be heated with almost the same facility as metals enables it to be used for such widely divergent processes as glueing and case-hardening, plastic sheet fastening and soft-soldering.

The greater efficiency and convenience of high-frequency heating is well shown in annealing and case-hardening processes, for which it is well adapted. For repetition work a heating coil is specially designed to apply the heat locally with the maximum of efficiency, and the result is a uniformity of heat treatment which is unobtainable by any other means. Examples of G.E.C. coils are illustrated herewith. Not only is the time of heating reduced to a few seconds in some cases, but it is possible to guarantee the depth of treatment to within a fraction of a millimetre in every specimen. The case-hardening of bicycle sprocket wheel teeth is illustrated in an accompanying engraving.

Although medium power generators of 1 to .5-kW capacity are commonly used, there is an increasing demand for higher powers, such as 25kW, which are capable of heating as much as 40 lb of ferrous metal through 100 deg. Cent. in a minute. Objection is occasionally raised to the high initial cost of such equipment, particularly if the process for which it is initially required is not the main item in the assembly costs. This objection is met by pointing out that with a portable generator and a wide variety of heating coils or energy "applicators," it is possible to adapt it to a large number of processes in the same factory. An example of this is given by a manufacturer of switches, who found that by borrowing the h.f. generator used for steel-melting in another part of the factory it was possible to treat a six months' stock of a small component in one afternoon.

Electronic Production Control

The use of the photo-cell in control of production, such as in the checking of labels on cans, alignment of paper on reeling, and safety protection in power presses, is now well known. Photo-electric and other forms of electronic control have recently been carried to an extreme by the development of an all-electronic production line for the mass manufacture of radio receivers by J. A. Sargrove (Sargrove Electronics, Ltd.).†

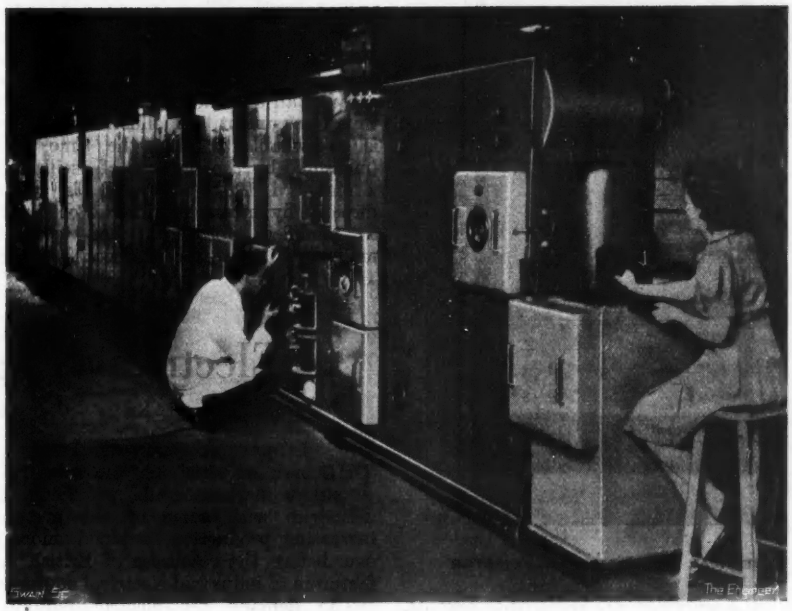
In this equipment, illustrated herewith, a simple radio receiver is assembled from plastic sheets, suitably moulded and sprayed with conducting metal to form the circuit connections and small components. The equipment operates entirely automatically, the moulding, spraying and grinding processes being automatically checked and shut down in the event of fault or departure from standard limits. The principle of this equipment can be adapted to the mass production of small component assemblies to any desired degree, the main feature being the ingenuity shown in adapting known electronic control methods to the production system required.

Electronic Regulation and Measurements

The use of electronic regulators to control the speed or voltage of electrical machinery has already been demonstrated with success, and with the present fluctuations in power supply from the grid network, it is expected that further extensions of thyratron control gear will be made.

A lesser-known application is in the speed control of small motors operating under rapidly fluctuating conditions of load, or in the control of alignment during reeling. Speed regulation can be obtained over a range of 10 : 1, the initial setting being made by a small rheostat mounted near the motor. Once set, a regulation of $\pm 0{\cdot}1$ per cent can easily be obtained. As one of the objections to the use of small a.c. motors is their comparative inflexibility, this application of electronics will become widely adopted.

The use of electronic measuring instruments, though still mainly confined to the laboratory, is in many cases expanding into factory processes, particularly if the measurement is associated with the acceptance or rejection of the finished product.



ELECTRONIC CIRCUIT MAKING EQUIPMENT

* Editor: *Electronic Engineering*

† See *Jour. Brit. I.R.E.*, Vol. 7., No. 1, page 2, 1947

Cathode ray tube equipment is now used for the detection of faults in armature windings of small motors, short-circuited turns in field coils, and the dynamic balancing of rotors. Vibration measurement plays a large part in the design of new types of power plant, and this work is not confined to the aeroplane industry. More recently gas turbines and some types of reciprocating engines have been modified as a result of the tests made with multi-channel electronic vibration indicators.

A characteristic of vibration measurement equipment is the low frequency at which the amplifiers are required to operate, and this introduces new problems of reduced internal noise level in the thermionic valves and uniform amplification over a range of 1 to 10,000 cycles per second.

A possible solution to the difficulties of high amplification coupled with low external interference effects will be found in the magnetic amplifier, such as the one made by Electro-Methods, Ltd., as illustrated on this page. This is not strictly an electronic device although its characteristics usually require it to be preceded or followed by thermionic valve stages. Originally developed in Germany during the war, these amplifiers make use of the non-linear properties of the magnetisation curve of transformers and with a d.c. winding to control the operating characteristics it is possible to obtain an amplification of small currents of the order of 1000 times. Apart from the disadvantage of requiring an appreciable power input, they have several points in their favour, the main ones being indefinite life and extreme robustness. It is almost certain that electronic amplifiers of the future will incorporate a magnetic amplifying stage where these features are of prime importance.

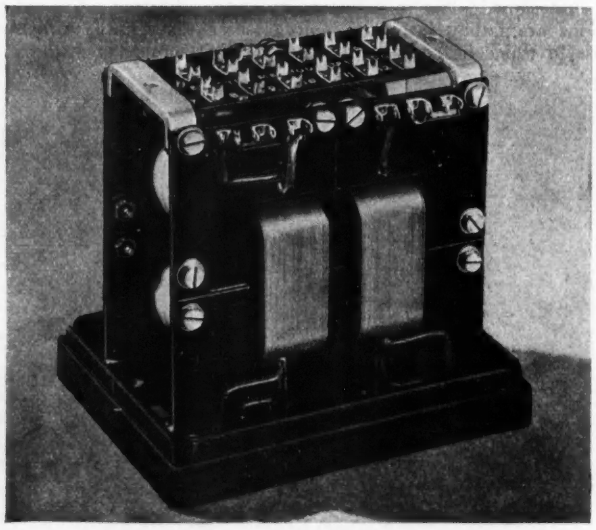
During the war, research on the ballistics of projectiles was considerably helped by the design of a special precision chronometer, made by Cinema-Television, Ltd., and capable of measuring time intervals electronically to an accuracy of 1/100,000th second. This instrument, as illustrated herewith, is remarkable in that the time interval (measured by the number of oscillations of a standard 100kc/s crystal) is indicated directly by means of a series of dials. In a modified form it has now been made available for industrial measurements requiring a high degree of precision.

Electronic computing apparatus, of which the ENIAC was the first example, is being developed on more elaborate lines by the Department of Scientific and Industrial Research, and while the versatility of the circuits will never be such as to warrant the title of "electronic brain," later models will posses attributes analogous to those of memory and discrimination.

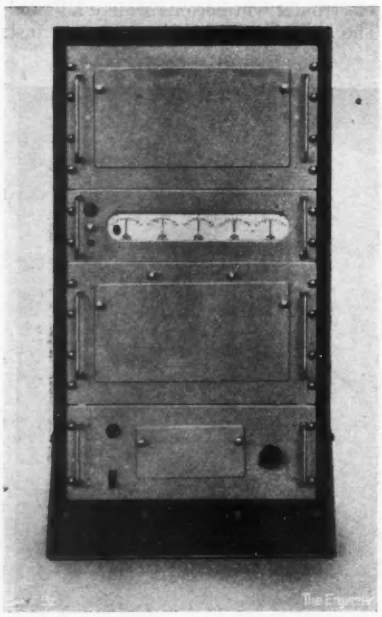
Intensive research on cosmic rays and radioactive phenomena has stimulated the commercial production of Geiger-Muller counters, of which several types are now available. Typical equipment is capable of detecting $0{\cdot}1\mu$gm Ra at 1m, and can count particles arriving at the rate of ten per second or faster.

One of the difficulties with the increasing applications of electronic techniques is in discriminating between the devices of genuine merit and advantage to industry and those in which electronic practice is exploited for the sake of novelty or an increase in sales. British electronic industry is fortunately free from practices of this sort and the potential importer of certain equipment, before complaining that this country lags behind in certain developments, may ask himself whether they are altogether essential for speeding up manufacture.

HEAT TREATMENT OF SPROCKET WHEEL TEETH



INTERIOR VIEW OF MAGNETIC AMPLIFIER



DECIMAL COUNTER CHRONOMETER

Electrical Engineering in 1947

No. IV—(*Continued from page 62, January 16th*)

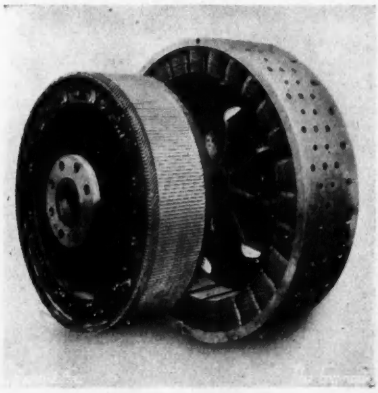
Industrial Electrification

THE task of satisfying the needs of the export market, while providing home industries with some of the means for increasing production, strained, more than ever before, the resources of British manufacturers of industrial electrical equipment.

The demand for electric motors, for example, so far exceeded the available supplies that some manufacturers found that they could make their most effective contribution by devoting almost the whole of their productive capacity to the building of standard ranges of machines. This preoccupation with the quantity of output did not, however, signify technical stagnation and a number of interesting new designs made their appearance.

Probably most of the technical requirements for polyphase, shunt-characteristic, variable-speed a.c. commutator motors are adequately met by the Schrage motor or by the stator-fed commutator motor with separate speed regulator. In spite of this fact the British Thomson-Houston Company, Ltd., found it worth while in 1947 to develop a new class of polyphase commutator motor with outputs up to about 10 h.p., and having a high starting torque and a speed variation of about 3½ to 1 in fourteen steps by the use of tappings on the stator winding. The three-phase stator winding of this motor (as described in *B.T.H. Activities*, July, 1947), is arranged to produce the effect of two fields in quadrature. One of these fields controls the excitation, the second

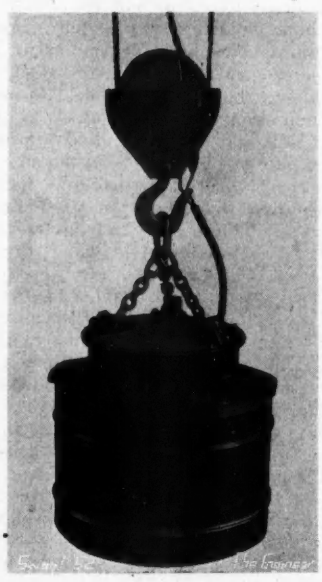
controls the armature volts, and the motor has a speed-torque characteristic similar to that of a shunt-wound d.c. motor, but steeper, so the change of speed with load is greater. For any given load torque the speed depends on the relative strengths of the quadrature fields and the necessary variation is produced by stator tappings.



ELECTROMAGNETIC COUPLING FOR SHIP PROPULSION

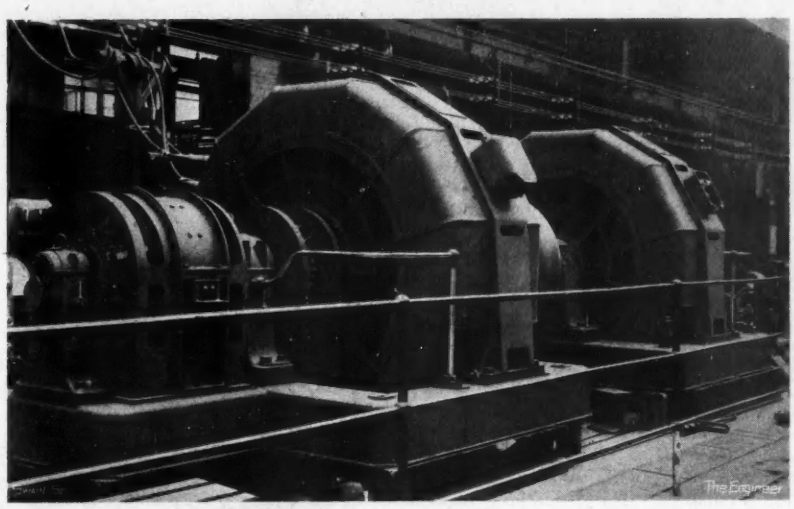
Another B.T.H. development was the introduction of a small size of Schrage motor with an output of 1 h.p. at 2200 r.p.m., and a 10 to 1 speed range at constant torque. The same company was also responsible for the evolution of an improved commutator construction in which each bar is supported throughout its length so that it can expand axially without any radial deflection. A prototype commutator built to this design and fitted to a 1250-kW, 625/1400 r.p.m. machine has been running satisfactorily for eighteen months, as a result of which production on a commercial basis began in 1947.

A specialised application of the principles of motor design is the B.T.H. electromagnetic coupling which was developed for high-speed diesel engine ship propulsion drives, in which a damping coupling is required to isolate the reduction gear teeth from engine torsional oscillations. The first two electromagnetic couplings to be built in Britain for marine installation were completed in 1947. One of these units, rated at 1520 b.h.p. at 300 r.p.m., is illustrated herewith. Six couplings of similar design, for horsepowers ranging from 1520 down to 220, are now under construction.



MULTIPOLAR COIL-LIFTING MAGNET

The range of motors suitable for mining use was extended by the introduction of some new products. One of these was a range of Buxton tested flameproof motors made by the Brush Electrical Engineering Company, Ltd., for service in collieries and other situations where the risk of explosion is high. These machines, which are now being manufactured in large numbers, have steel barrels and are of fan-cooled, blow-over construction, with either squirrel-cage or wound rotors. An example from this range, a 40 h.p. motor, is illustrated overleaf. Another development (described in THE ENGINEER, February 7, 1947) was the range of heavy-duty a.c. colliery motors made by the English Electric Company, Ltd. These induction motors are drip-proof, and the slip-ring machines can be supplied with flameproof enclosures carrying Buxton certificates. The stator terminal box can be fitted alternatively on either side of the motor, and the fittings are reversible so that the cable or conduit entry can be upwards or downwards, as required.



700-H.P. SYNCHRONOUS INDUCTION MOTORS UNDERGOING BACK-TO-BACK TESTS

Prominent in the work for export completed by Bruce Peebles and Co., Ltd., was an order for 700 h.p. synchronous induction motors for driving air compressors at a gold mine on the Gold Coast. These machines were designed to run at 250 r.p.m. operating on a three-phase, 50-cycle, 3300-V supply. One of the accompanying illustrations shows two of the motors undergoing back-to-back tests at the maker's works.

ROLLING MILLS

Of the many orders received by British manufacturers for rolling mill drives two only will be mentioned here. The twin-drive reversing mill equipment which will be installed in South Wales by the English Electric Company, Ltd., is interesting because each roll of the single stand is to be driven by a separate d.c. double-armature mill motor, dispensing with a pinion housing. This will be the first drive of its kind in this country. The double-stand r.m.s. horsepower will be 9200 at 40/80 r.p.m., and the peak working torque of each motor will be 1,590,000 lb-ft. The controls will include a comprehensive system of interlocks to protect the plant against such contingencies as overload and lubrication failure. Special precautions will be taken to prevent carbon or copper dust from entering the electrical machines and the ventilating equipment will include precipitation plant for cleaning the make-up air in the machine room.

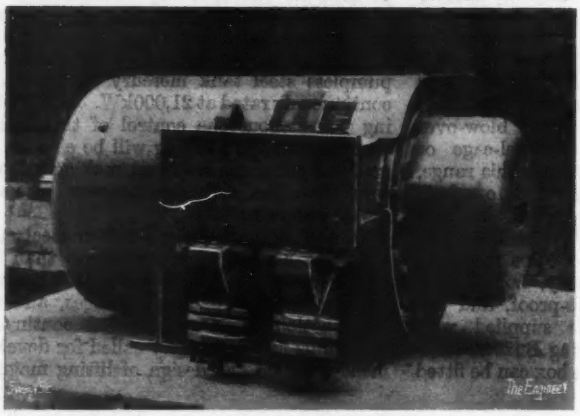
In the new wide hot strip mill of the Steel Company of Wales, B.T.H. drives will be used for the finishing stands which will include six d.c. motors having an aggregate horsepower of 23,500. These motors will be supplied from a bank of thirty B.T.H. pumpless steel tank mercury arc rectifiers, continuously rated at 21,000kW. An interesting point about the control of this mill is that inching and starting will be effected by grid control of the rectifiers, making a departure from the orthodox practice of using motor generator sets.

Of the auxiliary services in a steel strip mill, few can be more important than the arrangements for handling the rolls between the various manufacturing stages, and the construction of a number of continuous strip mills in this country called for development work on the design of lifting magnets capable of lifting heavy coils of cold rolled steel strip on end. To meet this demand the Igranic Electric Company, Ltd., extended its range of lifting magnets by introducing a new design known as the class 61423/1 multi-polar coil lifting magnet, as illustrated in an accompanying engraving, which is reproduced from a photograph of a scale model.

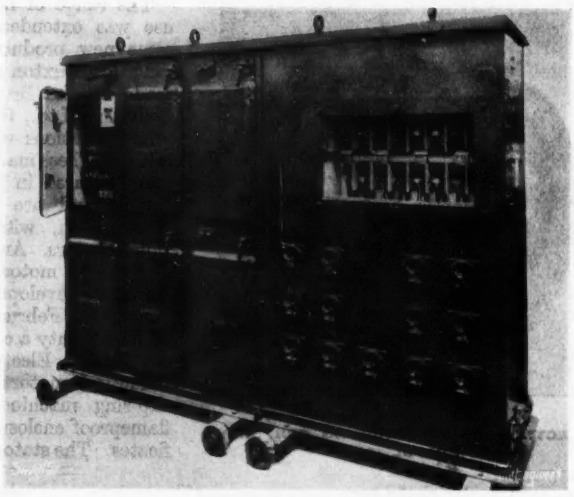
This four-pole magnet has alternate poles wound, the design being such as to reduce the magnetic circuit to the shortest possible length and to give good protection to the magnet coils. The diameter of the top plate is reduced to the minimum to allow the crane driver a clear view of the pole pieces and the circumference of the coil so as to simplify the process of lowering the magnet on to the coil. At present, the range of magnets comprises three sizes with nominal lifting capacities of 16,000 lb, 25,000 lb and 45,000 lb, respectively, and a series of pole pieces is available to suit various outside diameters of coil within the lifting range of the magnet. An important aim of the design is to secure a high ratio of lifting capacity to deadweight, and the extent to which this is achieved can be assessed by the fact that the largest magnet with its nominal lifting capacity of 45,000 lb has a designed deadweight of only 9200 lb.

Each magnet in the range is designed to

lift, with a good factor of safety, a coil of strip having a winding irregularity of approximately ¼in. If the irregularity of winding exceeds ¼in, it is recommended that the next larger size of magnet should be used. We are informed that the makers hope to extend the range of this design to include a magnet with a lifting capacity of 100,000 lb, which will meet the maximum requirements at present anticipated.



40-H.P. FAN COOLED FLAMEPROOF MINING MOTOR



AUTOMATIC CONTROL BOARD FOR POWER STATION AUXILIARIES

Turning to motor control gear, progress in 1947 was measured not by any spectacular strides but rather by design improvements, aiming at simplification. At the same time, there was continued evidence of the trend towards automatic control particularly by electronic techniques, some aspects of which are discussed briefly in an article "Electronics in Industry," which appears elsewhere in this issue.

In the present article we must, however, content ourselves with a short reference to the equipment which is illustrated above, as a good example of modern practice in the automatic control of motors driving power station auxiliaries. This Brookhirst control board which is installed in the "Back of the Bank" power station, Bolton, provides an interesting application of Brookhirst "Isofuses" for controlling various distribution circuits. The "Isofuse" is a self-contained unit consisting of a quick make and break switch, embodying rewirable fuse elements. Thirteen of these units are built into the control board illustrated, and two further units can be included in the blanked-off positions. The "Isofuse" is in two parts, each mounted on complementary die-cast plates, one of which supports the fixed contacts while the other supports the fuse carrier and moving contacts. By loosening a non-removable screw, it is possible to withdraw the complete unit and the design embodies safety interlocks.

Cables

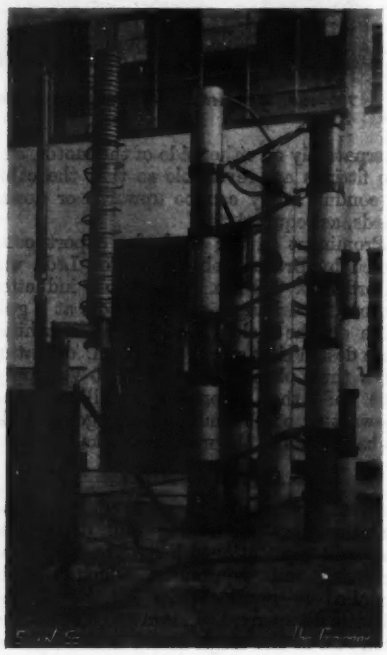
Matters of considerable moment to cable manufacturers and users alike were discussed in an important paper, "Standardisation of Power Cables," which was presented by W. H. Lythgoe before the Institution of Electrical Engineers. Summarising the present state of development in the power cable industry, this paper concluded that although the applications of power cables are more diverse than ever before, the point had been reached when an extensive review was justified, with the object of reducing the number of standards to the minimum necessary for modern requirements.

The new Anglo-Dutch submarine telephone cable which was laid in 1947 between Aldeburgh, in Suffolk, and Domburg, in Walcheren, attracted considerable interest because of some novel design innovations. This cable used "Telcothene," a mixture of polythene and polyisobutylene, as the main insulant and incorporated an air space around the conductor to reduce the losses. A tabular summary of the electrical characteristics of this cable is as follows:—

Effective dielectric constant	1·66
Capacitance	0·134μf per nautical mile
Power factor	0·0002 approximately
Impedance	60 Ω from 10kc/s upwards
Attenuation at 0·55Mc/s ...	0·95 db per nautical mile

Research

It is outside the scope of this article to attempt even a brief review of progress in research in an industry whose products range from turbo alternators to synchrotrons and from mercury arc rectifiers to fluorescent lamps. To indicate the scope and importance of research in electrical engineering, therefore, we can do no more than to single out by way of illustration a few examples of work of immediate practical significance, passing over for the time being much of the interesting investigations which are directed to long-term objectives.



1,000,000 VOLT IMPULSE ACCELERATION OF X-RAYS

Nuclear physics, largely through force of circumstance has passed the stage when physicists could pursue their researches satisfactorily with "home made" laboratory apparatus. Fundamental progress in this subject depends to an increasing extent upon the engineering production of equipment such as that required for accelerating electrons and other particles. Accordingly, a number of British manufacturers are now actively engaged in the design and manufacture of such equipments as betatrons, synchrotrons and other kinds of accelerator.

During 1947 a novel form of betatron, for outputs of 10 to 15 million electron volts, was ready for preliminary tests at the B.T-H. works. This betatron, which is for use in the Clarendon Laboratory, Oxford, departs from previously established designs in two ways. First, the a.c. magnetic field which serves to guide and focus the electrons in a circular path, is quite separate from the a.c. magnetic field which accelerates the electrons. The use of two separate fields allows the accelerating field to have a continuous iron path and results in a reduction of kVA and weight required to produce a given output. The second departure from the more orthodox design follows logically from the first and consists in a reduction in the cross-section of the "doughnut"—the hollow evacuated toroid in which the particles are accelerated.

In THE ENGINEER, November 14, 1947, we referred very briefly to some of the activities of the English Electric Company in the design and construction of equipment for nuclear physics research. In addition to building synchrotrons for 30 and 140 million electron volts respectively, this company brought to an advanced stage the constructional work on two electrostatic generators designed for 2 and 5 million electron volts, respectively, working in an atmosphere of nitrogen at 400 lb per square inch pressure.

Even more interesting perhaps is the apparatus, illustrated herewith, which the English Electric Company is building for accelerating particles by high impulse potentials. A generator of the well-known Marx pattern produces impulse potentials of 1,000,000V, which are applied to the accceleator tube (on the left of the engraving) to accelerate the electrons emitted from a cold cathode. Intense rates of gamma-ray dosage can, it is claimed, be produced

by using the accelerated electrons to bombard a suitable target. This equipment has interesting applications in therapy and the sterilisation of food. Another company which is actively engaged in the development and manufacture of particle accelerators is the Metropolitan-Vickers Electrical Company, Ltd.

An interesting advance in the design of fluorescent lamps was the introduction of the new calcium halophosphate phosphors in the form of coatings, which increased the luminous efficiency of the lamps by nearly 50 per cent. As described in an article in the G.E.C. *Journal*, these new phosphors were discovered and applied in the research laboratories of the General Electric Company, Ltd.

In the important field of dielectrics a noteworthy development was the work done by the British Thomson-Houston Company, Ltd., on the possibilities of producing synthetic mica, as a result of which a small, successful melt was made. The raw materials—silica, calcined alumina, calcined magnesium oxide, and synthetic potassium cryolite, were melted at about 1400 deg. Cent. in a graphite crucible in proportions which, allowing for volatilisation losses, will produce a melt of the required composition. Crystalline mica was obtained from the melt by appropriately controlled slow cooling.

Civil Engineering in 1947

No. II—(*Continued from page 61, January 16th*)

Some Work on British Railways

DESPITE the difficulties caused by shortages of materials, a fairly large amount of engineering work was carried out by the main line railway companies in this country during 1947. The renewal of permanent way was pushed ahead and some important junction renewals and resignalling work were effected during the year.

One junction renewal of particular note was that carried out by the L.M.S. at the approaches to St. Pancras station, and which was described in our issue of November 14, 1947. These approaches comprise five running lines, two of which are goods lines, and access to the seven station platforms is obtained through four double slips comprising the junction and its attendant connections. The renewal was necessitated by the increased size and weight of the engines, which made it imperative to realign the track and improve the radii of the connections as a whole. The relaying of the track was accompanied by a considerable amount of signal and telegraph work. For this renewal, which was carried out in nine stages, the whole of the track was manufactured by Taylor Brothers (Sandiacre), Ltd., as a built-up and timbered lay-out, and it was laid in by means of cranes.

On the L.N.E.R. the extensive renewal of the lay-out at Newcastle Central Station involved the replacement of double slips, switch diamonds, switch diamond slips, and turn-outs, all of special design and closely interlaced. Some twenty-seven sets of points and four sets of switch diamonds, all of which are power operated, were included in the renewal. Although the tracks carry extensive traffic, and only limited possession was available at one time, this work was completed in six week-ends.

A considerable length of permanent way was renewed during the year—nearly 500 miles on the L.N.E.R. alone—and for this class of work the method of pre-assembling lengths of track and setting them in position by cranes was extensively adopted.

On the Southern Railway some interesting "blanketing" work was carried out to improve the track foundations at Malden, Clapham Junction and Paddock Wood. At these places soft clay below the ballast made it very difficult to maintain the track in a satisfactory condition for high-speed traffic, particularly during the winter months. Blanketing is effected by removing the clay to a predetermined depth beneath the track and replacing it with an adequate depth of more suitable material. The depth of new material introduced is determined by the physical properties of the ground below the track, which is first investigated by means of bore-holes. Some particulars of the work at Paddock Wood were given in our issue of November 28, 1947.

Early in the year the Southern Railway Company completed the reconstruction of the Blackfriars Bridge which carries the Loughborough Junction and City line between Elephant and Castle Station and Blackfriars Junction over the south-eastern section Charing Cross lines between Waterloo Junction and London Bridge. This bridge is some 52ft wide, carrying four tracks and spanning 170ft between abutments, and has two brick piers.

NEWCASTLE CENTRAL STATION APPROACHES

DRIVING THURGOLAND TUNNEL—L.N.E.R.

When the proposals for the reconstruction of the bridge were being considered, it was borne in mind that, in view of possible post-war developments, it would not be advisable to proceed with an elaborate scheme for permanent reconstruction. The scheme adopted, therefore, was of a semi-permanent nature, of the way-beam type of construction, similar to that commonly used during the war for the temporary reinstatement of bridges damaged by enemy action.

The design adopted necessitated the removal of the entire deck and cross-girder system by cutting it away from the main girders, together with the removal of the centre main longitudinal girder, leaving only the two outer main girders in position. New crosshead girders constructed between the three existing central stanchions were arranged to act as a central support to the new deck and were designed to form part of the possible future permanent structure. New concrete bearing pads were cast in situ at the abutments and piers. The way-beams, of which there were four per track, comprised plated R.S.Js., suitably braced and pre-assembled into units, each sufficient to carry one track over one span. After placing in position they were joined together at their ends by welding in such a way as to make them continuous over the main supports. The track is carried by longitudinal timbers supported between the way-beams, and precast reinforced concrete units form the new deck.

On the L.N.E.R. work was proceeding on a new single-line tunnel which is being built alongside the existing double-line tunnel at Thurgoland between Wortley and Penistone on the Sheffield–Manchester

main line. The construction of this tunnel will necessitate the removal of about 70,000 tons of rock and earth.

For some time the traffic on this route has been restricted owing to the limited clearances in the existing double line tunnel, and the advent of the proposed electrification of this section of line has brought the matter to a head. The tunnel is about 320 yards long, with rock cuttings at both ends and is driven throughout in poor rock. Work was started in November, 1946, but progress has been slow owing to the almost continuous support required for the poor rock mentioned above. Labour shortage and weather conditions during last winter increased the delay which has taken place in completing the work. The tunnel is being driven from both ends and excavation is now about 70 per cent completed. The new tunnel will be lined throughout with concrete, and it will accommodate the down line. It is proposed to slew the up line into the centre of the existing tunnel so as to provide the clearances which are desired. Work in progress is illustrated herewith.

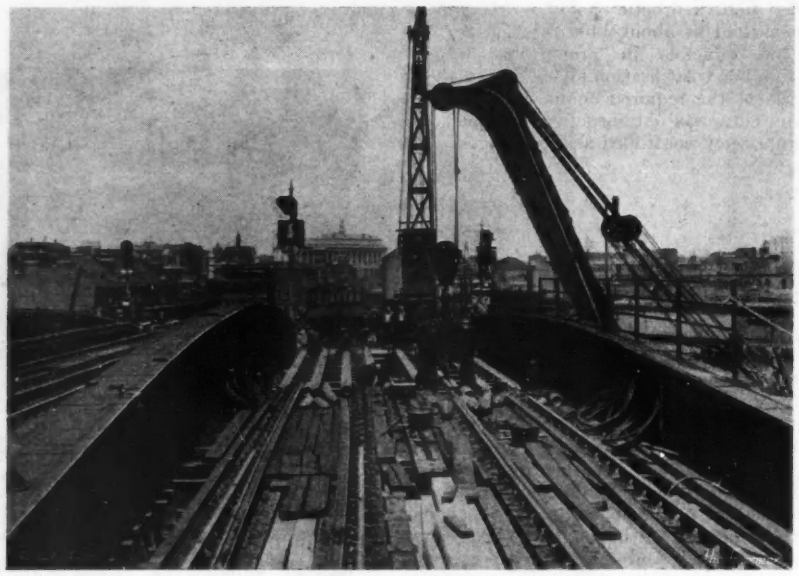
The engineers for this work are the chief engineer of the London and North-Eastern Railway Company, Mr. G. B. Barton, M.I.C.E., and Sir William Halcrow and Partners, MM.I.C.E., the contractors being John Cochrane and Sons, Ltd.

Extensive remedial measures were undertaken to a landslip in a cutting near Grantham. This was about ¼ mile long and involved excavation which in bulk amounted to some 118,000 cubic yards of material. Mechanical plant which was largely used in this work included scrapers, bull dozers and excavators.

At New Holland work by the L.N.E.R. Company has been in progress on the renewal of the West Pier head, which is being carried out in reinforced concrete. Pre-stressed concrete is being used in the decking and it is believed that this is the first example of such use in this country.

Resignalling in connection with the extension of York Station has been continued. This work involves the provision of a new central box to replace eight existing boxes. In the new scheme route relay interlocking with colour light signalling and electro-pneumatic point operation is being employed. When completed this will form one of the largest signalling installations of its kind in the world.

In connection with the Liverpool Street–Fenchurch Street–Shenfield electrification a fly-over viaduct at Ilford was introduced. This viaduct transposed the main lines and the local lines between Ilford and Liverpool Street.



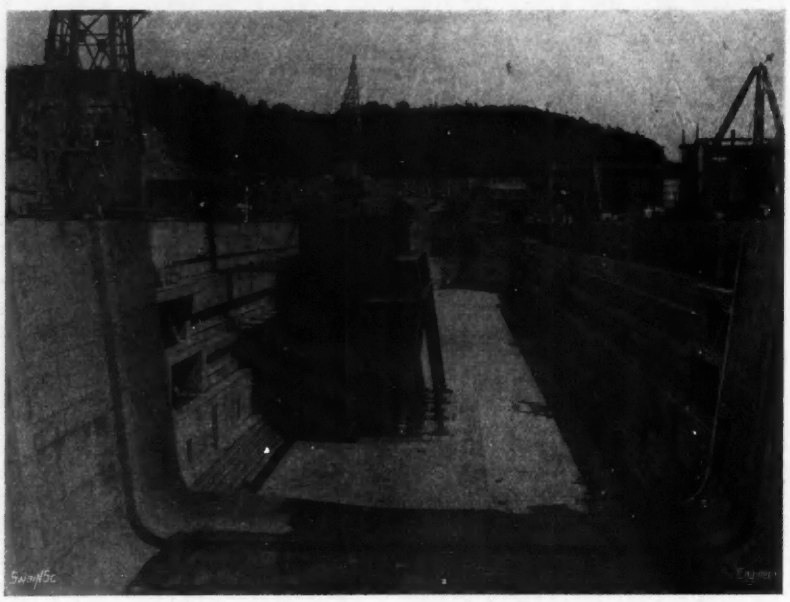
BLACKFRIARS BRIDGE

"Princess Elizabeth" Graving Dock, South Africa

A notable event last year in South Africa was the formal opening on March 3rd by H.R.H. Princess Elizabeth of a new graving dock at East London, named after her. An accompanying illustration shows the dock and caisson, or dock gate, under construction. It is 723ft long, 102ft 3in wide, and 32ft 6in deep at low water, and can accommodate ships of up to 17,000 tons. Begun during the war, it was completed in nearly five years at a cost of £1,693,000.

Many difficulties were overcome in its construction. Excavation was carried out within a sheet pile cofferdam, but when pumping was begun, seepage was greater than the pumps could handle. It is interesting to note that manure was shovelled against the seaward side of the piling and small particles in sinking were drawn into the pile clutches and found effectively to seal them.

Owing to the prevailing westerly winds at East London, a landing quay was considered an essential adjunct to the graving dock. The landing quay is 684ft long, with 30ft of water available at low tide.



"PRINCESS ELIZABETH" GRAVING DOCK UNDER CONSTRUCTION—S. AFRICA

Crown Agents for the Colonies

Work was continued under the Crown Agents during the year on the ordering and supply of materials for the new railway in East Africa to serve the ground nut scheme and link it with the port to be built at Mikindani. The construction of the line, about 150 miles long, was begun, the general manager, Tanganyika Railway, being responsible.

On the west coast, tenders were called for a deep water quay at Freetown, Sierra Leone. As designed, the quay is 1200ft long, in concrete block construction. The contract includes additional reclamation work, dredging in front of the quay to a depth of 32ft below l.w.o.s.t., and the construction of three main sheds each about 300ft long and 75ft wide.

In Nigeria investigations and surveys at site and the design of road bridges were carried out by engineers from the United Kingdom, including a party from the Crown Agent's office. This work was put in hand in consequence of a big programme of new road construction proposed by the Government of Nigeria, including a road from Lagos to Benin, some 150 miles long.

Design work for a number of bridges was undertaken by the Crown Agents. The steelwork for each will be fabricated in the United Kingdom, and erection will be undertaken by the Public Works Departments of the territory concerned. They include

a high tensile steel Warren girder road bridge for Trinidad, having 175ft span, the Dukkan road bridge over the Lesser Zab River in Iraq, the Queen's Park road bridge in Grenada, crossing the St. John's River with 133ft 6in span, and the Cayo suspension bridge at Honduras, spanning the Belize River. The last-named has a 280ft central span between steel towers, the two suspended side spans being each of 100ft.

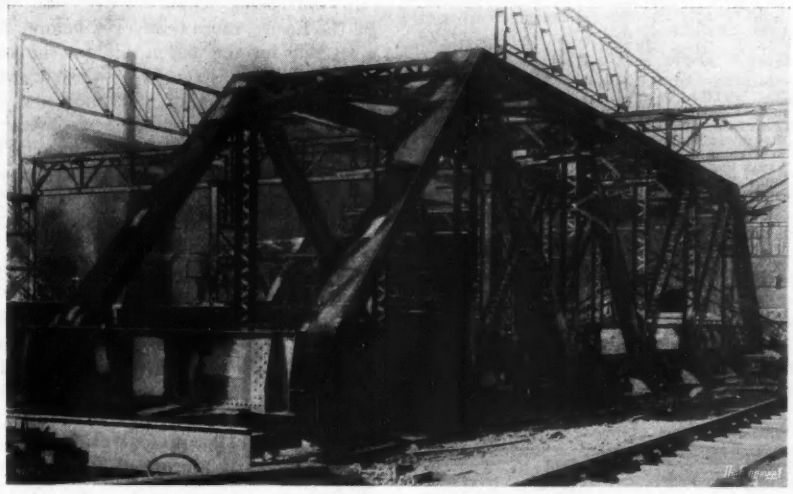
Esna Barrage, Egypt

During 1947 the Esna Barrage remodelling works in Upper Egypt and the Esna Barrage swing bridge were completed. The primary object of the scheme was to increase the working head on the barrage from 1·50m, as built in 1909, to 4·90m, thus giving greater protection to the basin land depending on the work and at the same time permitting perennial cultivation of a large area. The increased strength for the greater head was obtained by increasing the length of the floor, with suitable protection against creep and scour. The Egyptian Government decided to take advantage of the remodelling to make the barrage a main bridge over the Nile by increasing the road width from 6m to 12m, and by providing a heavy swing bridge over the lock.

The barrage remodelling began in November, 1945, and was completed in November, 1947. The construction of such a major work across the Nile had never before been accomplished in such a short time. The swing bridge was begun in July, 1947, and completed in December, 1947. For both works the engineers were Sir M. MacDonald and Partners and the main contractors Sir Lindsay Parkinson and Co., Ltd.

Burma

Some interesting work was in hand on the Burma Railways, mainly on the reconstruction of war damaged bridges, and by the Burma P.W.D. in connection with road bridges. An aerial view reproduced herewith shows the Gokteik railway viaduct in its damaged condition. Reconstruction involves the complete rebuilding of three trestles, the tallest being 320ft high, the repair of other trestles and the erection of four spans each of 120ft. The new work is being placed in position by an aerial ropeway sent out from England. The consulting engineers for this work are Messrs. Rendel, Palmer and Tritton, who act in this capacity also for the Ava railway bridge, involving temporary steelwork for the reconstruction of two spans, each of 360ft and for the supply of sixty spans of 100ft of through and half-through types for the rehabilitation of various other bridges on the Burma Railways. A typical 100ft span is the subject of one of our illustrations.



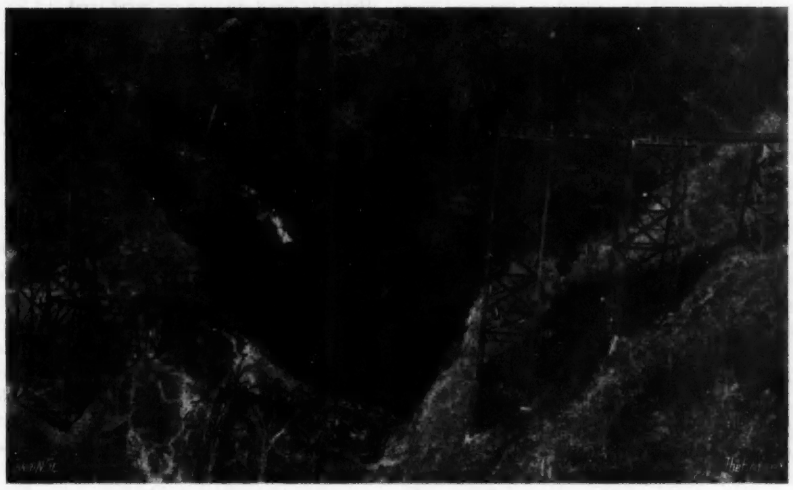
100ft Replacement Span for Burma Railways

The Burma P.W.D. is erecting a number of Callender-Hamilton unit construction road bridges, totalling 128 spans, up to 140ft long. The total weight of steel involved is about 15,000 tons. Messrs. Rendel, Palmer and Tritton are also consulting engineers for these works.

Australia

An interesting combined road and railway bridge was begun in Queensland over the Burdekin River, which in times of flood is impassable by road or rail and forms a barrier to communication between North and South Queensland. The design provides that the lowest part of the steelwork of the main trusses of the new bridge will have a clearance of not less than 10ft above the highest known flood level.

The general design on a site slightly upstream of the existing railway bridge comprises eight 45ft and three 60ft steel girder spans at each approach and ten 250ft main steel truss spans on concrete piers. The main substructure, which has been completed, comprises reinforced concrete piers and caissons with semi-circular ends 56ft long and from 18ft to 25ft wide. All were designed to be sunk 100ft below average river-bed level. For the superstructure there will be two steel through-trusses at 42ft centres for each span, carrying a 22ft reinforced concrete roadway and 3ft 6in gauge trackwork now, but with clearances and structural strength for a 4ft 8½in gauge railway. The bridge is scheduled for completion in 1950 at a cost of about £1,600,000.



Aerial View of Destroyed Gokteik Viaduct—Burma

In New South Wales preliminary work was begun on the Warragamba dam for increasing water supplies to Sydney. The catchment area of the Warragamba River is 3383 square miles, and it is expected that the reservoir will impound 450,000 million gallons. The height of the dam will be about 340ft, making it the highest in the Southern Hemisphere. Another dam in New South Wales on which work has begun is the Burrendong dam on the Macquarie river, 19 miles from Wellington. In this case the water will be used for irrigation. It will be a rolled earth-fill dam, using 5,500,000 cubic yards of material and will impound 520,000 acre-feet. Its height will be 170ft and the length along the crest 3500ft.

In Tasmania good progress was made, bearing in mind universal postwar difficulties, with the construction of Clark dam, forming part of a scheme for developing hydro-electric power from the headwaters of the Derwent River. This arch-gravity dam will have a vertical upstream face on a radius of 405ft, a crest thickness of 15ft and various radii to the downstream face, so as to thicken the arches towards their abutments. The main arch will be supported by two gravity thrust blocks, tangential to the arch, and the maximum thickness of the arch will be 83ft.

Smoke Control in the U.S.A.—It is reported by *Engineering News-Record* that smoke control agencies have been authorised recently in the areas of Los Angeles, Milwaukee and Pittsburgh. The American Municipal Association has stated that in these three areas counties are empowered to regulate air pollution without the approval of the several municipalities involved.

THE ENGINEER

JANUARY 23, 1948

VOL. CLXXXV No. 4800

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NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

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CIVIL ENGINEERS AND INDIA

No one will ever be able to say that in those many years during which Britain ruled India British engineers failed to do their best to raise the standards of living of the Indian peoples. British administration laid a "Pax Britannica" over the land. Under that peace British engineers laboured with much success to prevent famines, pestilences, floods and other disasters, to improve communications and to increase food supplies so that the population began a swift expansion and stands now at 410,000,000, increasing yearly by 5,000,000 souls. The successful work of engineers, indeed, by opening to warlike races the possibility of earning a livelihood peacefully did as much to pacify parts of India as regiments of troops. But unfortunately, the work of engineers in India has gone almost unsung outside the borders of that country. For those who built the roads and the railways, the bridges, the dams, the irrigation works, and the harbours did not conceive it to be a part of their job to see that all the world should know what they were doing. As engineers they were satisfied only that the job should be well done. Only now as India and Pakistan start to rule themselves are we beginning to realise what wonderful monuments to the skill and courage of British engineers have been handed over to the care of others.

How different now is the engineering situation in India compared to what it was! Whilst Britain ruled in India it was in the natural course of events that engineering works to be carried out in that sub-continent should be placed in British hands. Many of those works were designed and built in India by engineers who had made their life's work in that country. Now, with the ending of British rule and the very natural desire of native-born engineers to take over the reins, those men, the skilled successors of those who built the great works of the past, are being dispersed over the world. In the future, more than ever before, India must rely for the design and for the supervision of the construction of the very many projected engineering developments upon the work of consulting engineers living outside that country. The time has, in fact, gone when it could be complacently assumed that British engineers must necessarily be employed to extend further the beneficent work that they had so well begun. The Indian engineer contemplating or putting in hand the erection of a great dam or the construction of a great irrigation scheme will not necessarily look now to Britain for advice. Indeed, having but just freed himself from British tutelage he may feel a desire to look elsewhere. Nor need he look far. For since the present century opened, and particularly during the uneasy years between the wars, the Americans have built in their own land some remarkable hydro-electric and irrigation works of just the kind now contemplated in India, and some of those schemes have demanded the erection of high dams such as will be needed for certain of the Indian projects. It is true that between the wars consulting engineers from Britain were responsible for the building of many notable and remarkable structures all over the world. We can recall without the trouble of consulting our past issues such structures as the Pegu Yomas dam in Burma, the Shing Mun dam at Hong Kong, the raising of the Aswan dam in Egypt, the Sydney Harbour bridge in Australia, the Habbaniyah flood-control scheme in Iraq, still under construction, and the Sukkur barrage and the Howrah bridge in India, to mention only a few. But, though of no lesser merit, these works, receiving less publicity, failed to catch the imagination of the world in the same way as those carried out in America for the Tennessee Valley Authority, the building of the Boulder dam across the Colorado gorge, the construction of the great Grand Coulee dam or the erection of the Golden Gate suspension bridge. Nor can existing works built by British engineers in India be fully relied upon to carry the conviction to Indian engineers that British civil engineers are still the best in the world. They are magnificent monuments to British engineering genius in the past, just how magnificent can be judged from a perusal of an article by Sir Stanley Reed, that we print in this issue. But as Sir Stanley remarks: "The British engineer in India . . . had one defect; like Lord Roberts he did not advertise." Even amongst Indians we doubt whether there is a full appreciation of the work done by British engineers in India.

We cannot guess what fate has in store for India and for Pakistan. At present the political outlook is far from promising. But if the population of India, expanding at a rate of five millions per year, is to be supported and famine eradicated, it can be done only by soon putting in hand a number of the great irrigation works linked with the generation of hydro-electric power that are projected. There is no reason why British consultants should not be responsible for those works. But American engineers, having behind them the prestige of the erection of just such works of similar magnitude in their own country, are already very active in India. There is already a very present possibility, to judge from the Indian press, that they may be drawn by the Indian Government into the great Damodar valley project for irrigating 750,000 acres and generating 3,000,000kW, the Ramapad Sagar project for irrigating 600,000 acres and developing 75,000kW, and the smaller Machkund river project. It is true that the construction of such works in India, and, indeed, throughout the East in general, calls for qualities of improvisation, of tact in negotiation, and of perseverance in the face of unexpected difficulties, not required where structures are to be put up in the midst of a more fully modernised state. It is true, also, that British engineers have the advantage over the Americans of long experience of and familiarity with conditions in India. But it is nevertheless to be hoped that British engineering consultants will not rely too much upon the reputation of British engineers in India, however well founded, nor too fully upon their long experience of negotiating with Indians, and that they will be as active upon their own account as their American competitors. For it is not solely their own prosperity that is at stake. Where the British consultant is employed so is the British contractor and British contractors' plant. So also will British plant be specified for the permanent equipment and plant. Not the civil engineering consultants alone are concerned, but many of the heavy engineering industries of this country.

STEEL OUTPUT

IN the year which has just ended, the British steel industry produced 12,724,000 tons of ingots and castings, and thus exceeded the target of 12,500,000 tons set out in the Economic Survey for 1947. That highly creditable output was achieved despite a serious scarcity of fuel early last year, and despite the fact that throughout the year the limited supplies of coke and of scrap were a cause of continual anxiety. The necessary rate of supply was only maintained by drawing on diminishing stocks. Furthermore, for this high rate of production, British steelmakers had to rely to a large extent upon plant that was suffering from the wear and tear of wartime demands, and much of which stood in need of replacement. Moreover during the year it was clearly stated that the Government adhered to its intention to effect the nationalisation of the steel industry within the lifetime of the present Parliament. Thus to uncertainty about supplies there was added an uncertainty about the future ownership of the industry. For no one can foretell in advance exactly how the industry can satisfactorily be divided into nationalised and private sections. Yet despite these difficulties and perplexities steel production in 1947 still exceeded the Government's expectation. As the Chancellor of the Exchequer said last week, in surveying the steel situation, "the achievement un-

doubtedly looks encouraging, and for the climbing output of recent months managers and workers have earned national appreciation," an appreciation which, he hoped, would stimulate them to still greater efforts!

It is not unreasonable to believe that the Chancellor's hope will be fulfilled. For the mere maintenance by the men of the effort that was being exerted in the final months of 1947 would in itself be about sufficient to ensure the attainment of the 1948 target. It is the supply of raw materials that is likely to be a source of anxiety rather than that there may be any shortcoming on the labour side. At present there are reasonable expectations as a consequence of an increasing output that sufficient coking coal will be forthcoming to provide the 12,000,000 tons of coke which it is estimated British steel-makers will need this year. But the scrap situation will only become easier if difficulties over payment, collection and transport can be solved and substantial quantities of scrap can thus be imported from Germany. The limestone supply situation also seems to need examination if the planned steel output for 1948 is to be reached. Technical advances may help to economise the use of fuel and raw materials and in other ways to enhance output. For improvements in steel-making practice resulting from researches and investigations undertaken by the British Iron and Steel Research Association, the Iron and Steel Institute, and other organisations are, of course, continually contributing to the efficiency of the Industry. Thus, provided there is no failure of raw materials, scrap or fuel, and that transport delays can be avoided, there is no reason to believe that, within existing capacity, the task which British steel-makers have been set of producing 14,000,000 tons of ingots during 1948 cannot be accomplished. If, as is hoped, it is possible to import just over 500,000 tons of ingot and semi-finished steel which excess finishing capacity in this country could work up, there should be available this year, in all, rather more than 10,500,000 tons of finished steel with which to meet the nation's needs. Exports—not including goods manufactured from steel—are expected to take up 1,000,000 tons, and there will thus be left just over 9,500,000 tons for home consumption, compared with approximately 8,000,000 tons in 1947. The Chancellor of the Exchequer stated last week that the likely level of demand this year for finished steel was 1,000,000 tons in excess of that quantity. Steel will therefore have to be carefully allocated and steel users as a whole will not be able to get as much as they would like to have. Nevertheless, many exporting firms will, no doubt, find steel easier to obtain than it was in 1947. Such increased allocations are always welcomed. It is those sections of industry whose steel allocations in 1948 are to be reduced that are questioning whether the right decisions have been taken.

The difficulty of a Government that is attempting an overall and detailed economic control of a country's output is well illustrated by the steel supply situation. For the supply of steel controls the output of industry and if it falls short then certain industries must make fewer goods than they are in fact capable of making, and the public must go short of those goods. How is the Government to choose between those industries which are to have ample steel and those which are to go short? Our Government is concentrating rationally upon raising exports and therefore upon encouraging the export industries. Yet the shipbuilding industry, much of whose output is either directly exported or, in British hands, earns on the high seas valuable "invisible" exports, is this year to suffer from a reduced steel supply. Shipbuilding firms are naturally asking why. Moreover, though there can be no doubt about the necessity for a general policy of reduced capital investment as announced in a White Paper last year, criticism is immediately, and apparently with justification, directed against the attempt to save in any particular way. If steel is not to be available for the extension of factories and is to be limited for railway use, &c., how long can "make do and mend" methods continue to be satisfactory; and if the supplies of steel are to fall short of demand in 1948, it is also asked, why do we intend to export a million tons of it? If there were no controls upon the use of steel —or of other materials and goods in short supply—those whose need was greatest would obtain it by paying the highest price. In effect, as the ultimate consumer, the public would decide how steel was to be allocated by indicating its willingness to pay higher prices for some goods than for others. But that *laisser-faire* policy is no longer popular. Perhaps, indeed, it is no longer economically possible in a country dependent for food supplies upon its exporting capacity to a world short of food. The duty is thus thrust upon the Government of choosing for the public, and, since the supply of steel influences the supply of so much else, it chooses in effect and in some detail what the public shall or shall not be able to buy in its retail shops. We doubt whether any Government ever could be in a position to interpret in such detail the real wishes of the people it governs. The sooner, therefore, the output of steel grows to such a degree that all demands can be easily met the better. That happy time, however, will not arrive until the great modernisation and reconstruction scheme of the British Iron and Steel Federation, already very well in hand, begins to produce results.

Obituary

GEORGE RUSTON SHARPLEY

As briefly recorded in our last issue, the death took place on Sunday, January 11th, at his home, "Eastfield," Lincoln, following a short illness, of Mr. George Ruston Sharpley, the chairman of Ruston and Hornsby, Ltd., and its associated firms. Mr. Sharpley was in his 77th year, and had served his firm for over sixty years. His death will be deeply mourned alike by his workpeople and staff, for he was an outstanding leader in industry, whose constant aim was to raise the standard of industrial and trade practice, as between competitors, to the highest level of rectitude, which was set by his own deeply religious convictions. He was largely responsible for the growth of his firm and its feats of production in two world wars, and in the difficult years between them, when he fought hard and successfully for the maintenance of the business and the welfare of his workpeople.

Mr. Sharpley was the son of the late Mr. Henry Sharpley, a farmer of Limber, Lincolnshire, and a nephew of Mr. Joseph Ruston, one of the founders of the firm. He entered the Lincoln works at the early age of sixteen, at a time when the company was busily engaged on the construction of locomotives and excavators for the building of the Manchester Ship Canal. At that time much of the present Ruston works was farm land and the boiler shop was not then built. From the beginning, Mr. Sharpley had an engineering turn of mind and was interested in workshop practice and production, and it was not long before he was marked out for a managerial position. At the early age of twenty-three he was appointed works manager, and in 1918, when the two concerns of Ruston Proctor and Co., Ltd., of Lincoln, and Richard Hornsby and Sons, Ltd., of Grantham, were amalgamated, he became, along with Mr. David Roberts, of Grantham, joint managing director of the new Ruston and Hornsby Company, Ltd. Two years later, in 1920, he was appointed the sole managing director of the firm.

Few men had a wider and more varied experience in the problems of engineering

GEORGE RUSTON SHARPLEY

construction. In his early days Mr. Sharpley had mainly to do with steam engines and boilers, portable engines, excavating and agricultural machinery. Later on he assisted in laying the foundations of the Lincoln oil engine industry and saw its production change from the early slow speed horizontal type of engine—still greatly in favour—to the present high-speed vertical engine, with its wide industrial and marine applications. He had a receptive mind to new methods, especially those which tended to reduce production costs, and the works, extended and modernised under his past leadership, are widely recognised as now being among the finest of their kind in this country. He travelled widely in the interests of his firm, and in 1928 he made a world tour, in which he visited the markets served by Rustons, a visit which lasted about a year. Shortly before he was taken ill, he had planned to travel in the near future to America, Australia and New Zealand. He was a director of Ruston and Hornsby Australia (Proprietary), Ltd.

When the company's excavator business was taken over by Ruston-Bucyrus, Ltd., Mr. Sharpley became vice-chairman of that

company. He was also a director for many years of Ransomes, Sims and Jefferies, Ltd., of Ipswich, a firm with which Ruston and Hornsby, Ltd., has had for years a close association. At a later date, the firm acquired an interest in Davey Paxman and Co., Ltd., of Colchester, and Mr. Sharpley became chairman of that company, which, during the last war, made such an important contribution in supplying the power units for tank landing craft.

When, in 1939, the late Colonel J. S Ruston died, Mr. Sharpley took over the chairmanship of Ruston and Hornsby, Ltd., in addition to holding the office of managing director. In 1943 he retired from the position of managing director, but remained chairman of the company.

Even after he had retired from executive responsibilities, he continued his habit of spending a large part of his time in the shops rather than in the offices. He knew literally hundreds of his workmen by their Christian names and in no matter what shop he visited, he was invariably greeted with happy and contented faces. One of his great delights was to preside from time to time at those small and intimate functions in the Lincoln Board Room when presentations were made to employees who had served fifty years with the firm. Mr. Sharpley knew each of these men personally, and often reminded them of the small and frequently amusing happenings of the days when he worked beside them in the shops. Such recollections—and he had a marvellous memory—helped to dispel all shyness and often brought to light efforts honestly made to help on the business.

George Ruston Sharpley will always be remembered by those who were privileged to know him, as a man of integrity, who set himself high standards and inspired others to attain to them. He was always human in his dealings with his fellow men, especially his staff and his workmen. While he abhorred bad practice and slipshod workmanship and would not countenance any slackness in those who served under him, he was ever ready to make allowances for and sympathise with human frailty. His colleagues and workpeople always knew that whatever demands he made upon them, they were never greater than those that he made upon himself. He was a valued member of the Institution of Mechanical Engineers, of which he became a graduate in 1893, an associate member in 1897, and a member in 1900. Although he devoted himself entirely to the interests of the great firm he helped to create, he still found time to serve the City of Lincoln as a Justice of the Peace, and was City Sheriff in 1946.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

SURVIVAL OF THE PADDLE-BOAT

SIR,—I read with interest two articles in your issues of December 19th and 26th under the heading "Survival of the Paddle-Boat." There is one vessel not mentioned in those articles, which might, I think, have merited inclusion; she is the "Monarch," the property of Cosens and Co., Ltd. She was designed and built by my father, the late Trevisa Clarke, in 1888, at the yard of R. and H. Green, Blackwall. She was built of steel, and her dimensions were 210ft by 22ft 2in, by 9ft, gross tonnage 315. She was engined by John Penn and Son, with an inclined paddle-engine, single expansion, having two cylinders, 41in diameter by 48in stroke, taking steam at 30 lb pressure from one double-ended boiler under two funnels (originally bell-mouthed). She assisted in the evacuation from Dunkirk in 1940, and was subsequently employed by the Admiralty, being, I understand, the oldest vessel to wear the White Ensign during the late war. She is presumably still afloat, being shown in Lloyd's Register for 1946–7, and should therefore be entering her sixtieth year.

STEPHEN T. S. CLARKE.

London, E.C.3, January 19th.

SIR,—I enjoyed Mr. Tripp's paddle steamer articles, but would like to warn him that any doubtful statements on this subject may bring the wrath of the Clyde steamer enthusiasts on his head. I have no claim to being a well-informed member of that fraternity, and have now no sources of information to consult, but I venture to disagree with Mr. Tripp on several points.

Unless things have changed the ships named from the Greek mythology are owned by the L.M. and S. Railway Company, the successors to the old G. and S.W. Railway, and not by the Caledonian Steam Packet Company. The fleets were kept under separate ownership after the railway amalgamation. I believe the reason was that steamers owned by railway companies laboured under certain legal difficulties.

The "Jeanie Deans" had a very chequered start, and her engines and boilers suffered several modifications. The old N.B. Railway were very conservative owners, and stuck to the single engine and haystack boiler long after the other railway companies had abandoned them, and though they changed over to modern machinery in the "Jeanie Deans," she was built with passenger accommodation much behind that provided in the contemporary C.S.P. Company turbine steamers.

Incidentally, the "Jeanie Deans" may be the fastest paddler on the Clyde to-day, but the old "Juno" and "Glen Sannox," and probably several other departed steamers could have given her a knot or two.

Triple-expansion paddle engines first appeared on the Clyde about thirty years before 1931, in the old "Marchioness of Lorne" and "Duchess of Fife." True, they were not very obvious triples, being two-crank tandem with two H.P. cylinders.

I must confess that the L.N.E.R's return to steam propulsion in the new "Waverley" has given me a good deal of satisfaction. The ancient Clyde ceremony of "looking at the engines" is a hollow mockery in the oil-electric "Talisman." W. MELVILLE.

Northwich, Cheshire, January 13th.

STANDARDISATION OF NATIONALISED RAILWAY STOCK

SIR,—In his second article on the nationalisation of railways, published in your January 9th issue, Mr. N. Johnson, under the heading "Standardisation," made some interesting observations regarding colour schemes, interior decoration, and the fittings of future coaching stock of British railways. Whilst agreeing to the need for standardisation of types of engines, rolling stock and components, he would apparently prefer to see the stock of the separate regions clearly distinguishable in the interest of maintaining a valuable competitive spirit between the regions.

This is one viewpoint, but there are others, and it would be of interest to learn your readers' views on the subject, as the Railway Executive will be taking important decisions on these and related matters in the near future, although the effects of such decisions will not be seen for some while. It is not clear why a decision to paint all stock to the same colour scheme would be "likely to result in the use of cheap pigment of uninteresting appeal to the eye," or to create a shortage of more valuable pigment and thus enhance the cost. The repainting would presumably be spread over a long period, as existing stock wasted out or became due for repainting.

The various interests of the Underground railways were merged in London Transport by a properly co-ordinated and aesthetically satisfactory effort, achieving an overall result which bettered the best of the separate lines.

On the question of components, surely only the best of those used by the separate companies should be retained. This, in itself, would effect a considerable saving. When occasion arises for redesigning such equipment as toilet fittings and sleeping and dining car furniture a favourable opportunity will present itself for an all-round improvement, and the introduction of fresh thought. It is to be hoped that the Executive will seek outside advice in this matter, as has been done with great success in some other and newer forms of transport.

N. E. KEARLEY.

London, S.W.1, January 16th.

The Institute of British Foundrymen

A SPECIAL meeting of the Institute of British Foundrymen was held in London on Friday last, January 16th, at which the opportunity was taken to express appreciation of the work which Mr. Tom Makemson has achieved in the foundry industry during his twenty-one years as secretary of the Institute. Mr. P. H. Wilson, the President of the Institute, was in the chair, and after paying fitting tribute to Mr. Makemson's work, presented him with a suitably inscribed silver tea service and a cheque. The President also read telegrams and extracts from several letters from foundrymen overseas who wished to express their high regard for Mr. Makemson. It is of interest to recall that Mr. Makemson was trained as a patternmaker and subsequently took charge of foundry and pattern shop apprentice training at the British Westinghouse Company—now the Metropolitan-Vickers Electrical Company, Ltd.—where he also served in the research department. After studying mechanical engineering for some time at the Manchester College of Technology, he took the Metallurgy course and was awarded the Associateship of the College. Mr. Makemson was elected to membership of the Institute of British Foundrymen in 1917, became honorary secretary of the Lancashire branch in 1923, and was appointed secretary of the Institute in 1926. He is also secretary of the International Committee of Foundry Technical Associations, the International Committee on Testing Cast Iron, and of the Manchester Association of Engineers, to which latter office he was appointed in 1927. During the war Mr. Makemson was seconded to the Iron and Steel Control, serving successively as deputy director, joint director and director for iron castings. In recognition of his work with the Control, Mr. Makemson was awarded the M.B.E., and in July, 1946, he resumed his full-time duties with the Institute. He has for many years been particularly active in matters connected with apprenticeship training and education, and is secretary of the advisory committee on examinations in foundry practice and patternmaking in the City and Guilds of London Institute. In recognition of his exceptional services to the foundry industry as secretary of the Institute, a position which it is hoped he will continue to occupy for many more years, Mr. Makemson received last year the E. J. Fox Gold Medal. At last Friday's ceremony the President's tribute was warmly endorsed by Mr. D. H. Wood, past-president, and after Mr. Makemson had replied, a lecture was delivered by Sir Arthur Fleming on "The Inter-Relation of the Engineering and Metallurgical Industries."

Prime Movers in 1947

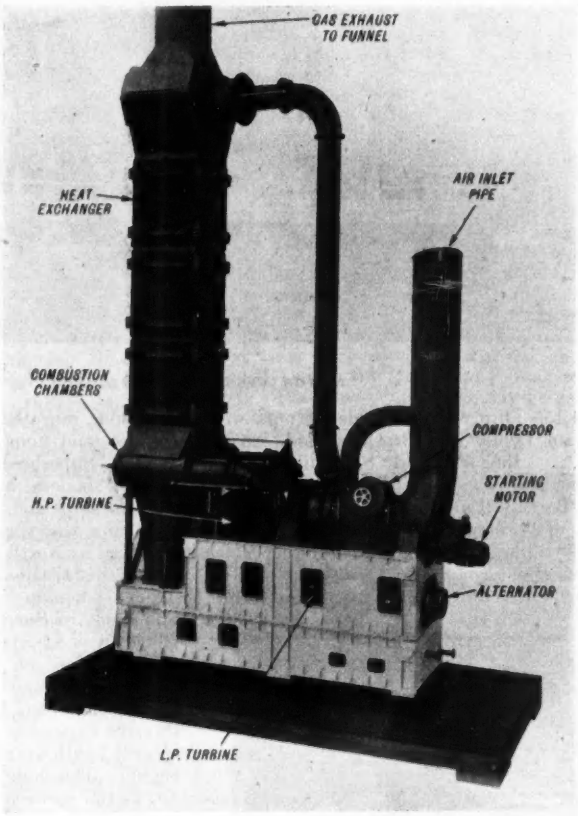
No. III—(*Continued from page 72, January 16th*)

METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD.

CONSIDERABLE progress was recorded during 1947 by the Metropolitan-Vickers Electrical Company, Ltd., in the design and construction of gas turbines for marine propulsion and the generation of electrical power. As already recorded in THE ENGINEER in our three descriptive articles of September 5th, 12th and 19th, the first gas turbine propelled ship, the experimental naval craft "M.G.B. 2009," went to sea on July 14, 1947. The installation consists of a Metropolitan-Vickers gas turbine developing 2500 s.h.p. and driving the central propeller. The trials, we are informed, were most satisfactory. After fifty hours' service, the gas turbine was removed from the ship and was brought back to the works, where it is now in course of being opened up for inspection. Further gas turbines of the same design and construction were manufactured in the course of the year.

Work is proceeding also on the construction of the 2500 h.p. gas turbine electric locomotive which, as recorded fully in our issue of January 17, 1947, is being constructed to the requirements of Mr. F. W. Hawksworth, M.I.Mech.E.

In connection with gas turbines for land power, the construction of a 2500-kW peak load gas turbine plant for the Metropolitan Vickers works power station is now well advanced.

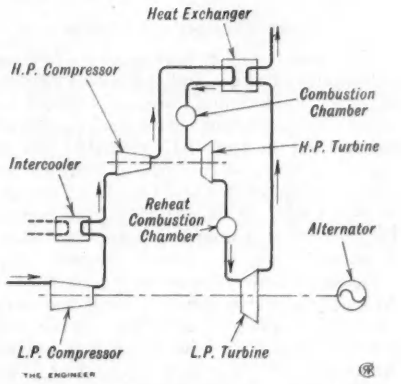


MODEL OF 1250 H.P. MARINE GAS TURBINE

Work has also been begun on the 15,000-kW gas turbine-driven generating plant for the Trafford Park power station. We may recall the recent announcement of Mr. H. G. Bell, M.Sc. (Tech.), M.I.E.E., the chief engineer and manager of the Stretford and District Electricity Board, that he had been directed by the Central Electricity Board to install this plant, which it is expected will be the first of its kind in this country. The power station is situated in the concentrated industrial area of Trafford Park, and the site restrictions imposed render gas turbine plant particularly suited for further extensions. The plant is of the compound type, shown in the accompanying cycle diagram. The alternator drive it will be noted is taken from the low pressure turbine, which also drives the low pressure compressor. The high pressure turbine drives the high pressure compressor. The arrangement of the intercooler, the heat exchanger, the re-heat combustion chamber, and the main combustion chamber, with their connections to the air compressors and gas turbines, are shown in the cycle diagram given.

BRITISH THOMSON-HOUSTON COMPANY, LTD.

Good progress we learn was made in 1947 with the construction of a 1250 h.p. marine gas turbine, for the Anglo-Saxon Petroleum Company's oil tanker, 12,600-ton "Auris." That ship, which is now under construction, will be propelled by electric motors fed from four diesel-engine driven alternators, each of about 880kVA. It is the intention of Mr. John Lamb, the manager of the Technical Division of the Anglo-Saxon Petroleum Co., Ltd., to replace one of the oil engine-driven alternators by a gas turbine-driven alternator, which will enable extensive trials to be carried out at sea. In our last year's review we gave some general drawings of the arrangement of B.T-H. gas turbines for ship propulsion, but this year we are able to reproduce a photograph of a model of the gas turbine being constructed for the "Auris," which was seen at the Olympia Exhibition and also in the B.T-H. London showrooms. It consists essentially of a high pressure and a low pressure turbine. The low pressure turbine drives the alternator and this group is below the high pressure unit, which is directly coupled to the air compressor and the starting motor. The heat exhanger, which has the duty of raising the temperature of the compressed air before it passes to the combustion chambers of the turbine, is of vertical construction and the compressed air is delivered to it at the top. The heated air passes into the combustion chambers, which are seen at the bottom of the heat exchanger just above the high pressure turbine. The exhaust gases later pass to the funnel giving up their heat. The necessary supply of fresh air is drawn through a large diameter inlet pipe at the forward end of the set. The arrangement is neat and will not take up much floor space in the tanker engine-room



CYCLE DIAGRAM—15,000-KW GAS TURBINE GENERATING PLANT

N.V. PHILIPS GLOEILAMPENFABRIEKEN, EINDHOVEN, HOLLAND

An interesting development was described in our issues of December 12th and 19th when we published the story of the evolution of the Philips air engine. Several experimental types of this new prime mover were described and illustrated, and we were able to announce the forming of a new company, N.V. "Thermomotor," to combine the resources of the Philips and Werkspoor works in the development of Philips air engines in powers over 200 h.p. The first unit of this type is now well advanced in its construction and tests will be carried out in the Amsterdam works of Werkspoor in the early part of this year. In the Philips works a number of fractional horse-power air engines for driving small generators were designed, and a prototype unit of Vee construction with four cylinders for marine propulsion and road transport was running on test before the end of 1947. In that year the Philips organisation made contacts with several leading firms both in Great Britain and abroad, with regard to the future development and application of this new and interesting prime mover.

"DESIGN WEEKS," 1948.—The Council of Industrial Design, in co-operation with the Federation of British Industries, the Association of Chambers of Commerce, and with the full support of the civic authorities, has completed the preliminary plans for the Design Weeks to be held in 1948 in Cardiff, Manchester and Birmingham. The programmes are based upon the experience gained from the first very successful Design Week held in Newcastle upon Tyne last July, and will include functions arranged for the general public, the distributive trades and for industry. The focal point being an exhibition designed by Mr. James Gardner, who was the chief designer of the "Britain Can Make It" exhibition. The programme for each of the Design Weeks will vary according to the character of the industrial region in which it is being held and the plan put forward by the organising committee set up in each city. These committees will consist of representatives of the civic and educational authorities, industrial and commercial interests, and voluntary organisations, in addition to the sponsors. The programmes will include a series of conferences between manufacturers, retailers and industrial designers, the showing of special films, and possibly exhibitions of the work of student designers and of national organisations.

Shipbuilding and Marine Engineering in 1947

No. IV—(*Continued from page 67, January 16th*)

Some Machinery Outputs

The year under review saw increases in outputs of ships and machinery in most of the shipbuilding areas. Almost all classes of propelling machinery were well represented in the 1947 returns. On the Clyde the largest output of engines was that of John Brown and Co., Ltd., totalling 86,000 s.h.p. This included the turbines for the new Cunard White Star Liner "Caronia," and the two Portuguese ships, "Patria" and "Imperio," and for the New Zealand Shipping Company's motor liner "Haparangi," also the motor train ferry "Suffolk" for the L.N.E.R. Company. Alexander Stephen and Sons, Ltd., completed 63,640 s.h.p. of machinery, which included turbines for a destroyer and geared turbines for other ships, besides sets of Stephen-Sulzer engines for the "Koromiko" and "Komata," two motor ships for the Union Steam Ship Company of New Zealand. These engines incorporate the latest developments in Sulzer design, but the tandem scavenge pumps at the forward end of the engine have been retained. They are six-cylinder engines with a bore of 600mm and 1040mm stroke, giving the 3700 gross ton ships, when fully laden, a speed of 13¼ knots at 128 r.p.m.

At Greenock, John G. Kincaid and Co., Ltd., completed 63,145 h.p. of machinery, which included three sets of double-acting, two-stroke, eight-cylinder, 9350 h.p. engines for Alfred Holt ships; supercharged, single-acting engines for other ships, and triple expansion steam engines. Some 35,000 h.p. of boilers were also built.

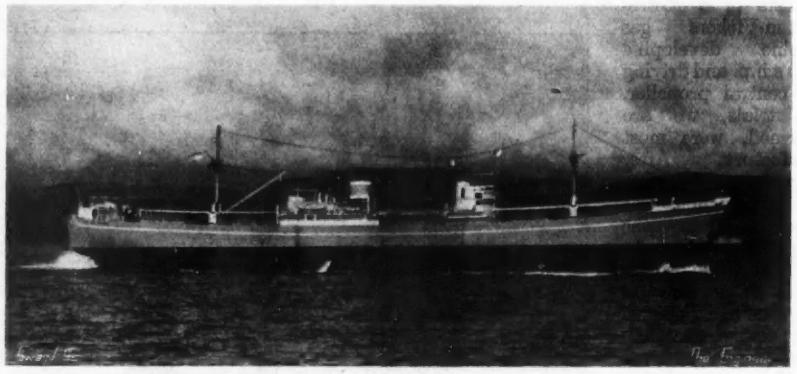
David Rowan and Co., Ltd., completed 51,500 i.h.p. of machinery for ten single-screw ships, which included geared turbines, Rowan-Doxford oil engines, and a triple expansion engine, with Bauer-Wach exhaust turbines. In addition, seven boilers were supplied, totalling 4577 i.h.p.

In Glasgow, Harland and Wolff, Ltd., finished 46,100 i.h.p. for five ships, while British Polar Engines, Ltd., had an output of 34,155 i.h.p. Other Clyde outputs were William Denny and Brothers, Ltd., 26,865 i.h.p.; the Fairfield Shipbuilding and Engineering Company, Ltd., 30,259 h.p., and Barclay Curle and Co., Ltd., 54,190 i.h.p. of Barclay-Curle-Doxford engines, also 30,160 i.h.p. of boilers and Bauer-Wach turbines and couplings.

At Scotstoun, Yarrow and Co., Ltd., built 72,843 s.h.p. of destroyer turbines for the British flotilla leader "Battleaxe," and the reconditioned Portuguese destroyer "Douro," and constructed 5040 h.p. of engines for twelve paddle steamers and motor launches for the Irrawaddy Flotilla Company, Ltd., eight of these ships being built at Scotstoun and shipped in pieces.

On the Tyne, the North Eastern Marine Engineering Company (1938), Ltd., made extensive alterations to its works to enable its Wallsend establishment to concentrate on the building of North-Eastern-Doxford engines, of which a considerable number were completed during the year with powers up to 4500 b.h.p.

In addition to these engines, 30,556 i.h.p. of triple reheated and triple superheated engines and four additional boilers were built. Superheaters were manufactured for 172 boilers, aggregating 164,000 i.h.p., for new ships and converted installations.

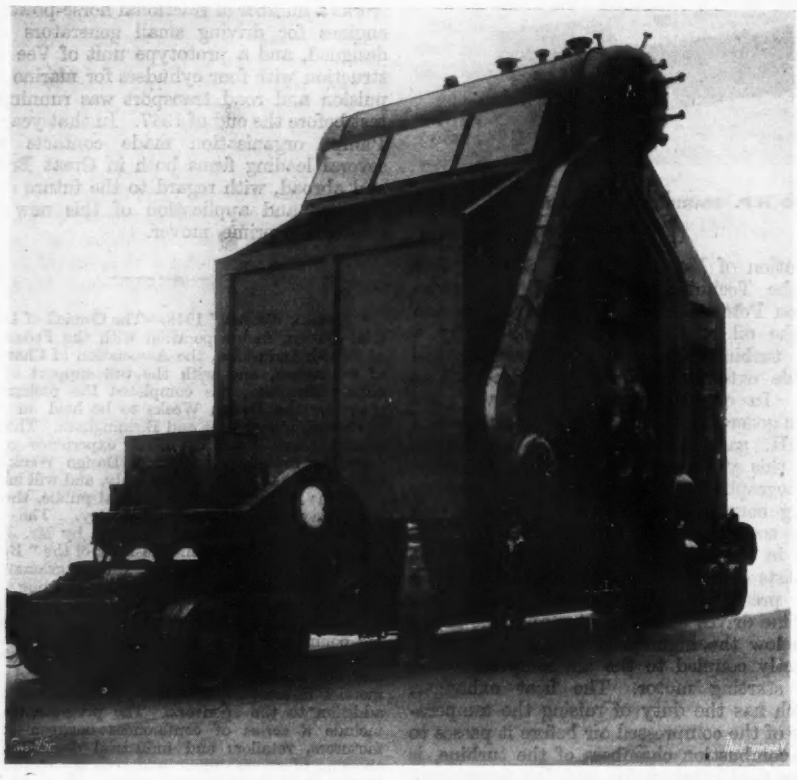


Motor Vessel "Rio Segundo"

During the year detailed test data was obtained by North Eastern Marine from a reheated installation installed in the "Sussex Trader," a ship built by Sir James Laing and Sons, of Sunderland, in which a boiler efficiency of 82·9 per cent, and a consumption of fuel oil per s.h.p. hour for all purposes of 0·766, 0·791 and 0·794 for three separate trials was recorded. These results are thought to disclose the highest efficiency yet recorded with a straight reciprocating marine engine. The boiler arrangement is of interest, as the position of the superheater is now moved from the centre to the wing furnace position, which gives more favourable starting and manœuvring facilities. At the Sunderland works of the North Eastern Marine Company there was a full programme of reheater engines which are now built in powers of from 750 up to 4200 i.h.p.

The associated firm of George Clark (1938), Ltd., of Sunderland, built thirteen sets of engines of triple saturated, triple reheated and triple superheated designs, and three boilers aggregating 39,321 i.h.p.

At the Hartlepool works of Richardsons Westgarth and Co., Ltd., geared turbines and Foster Wheeler boilers were completed for the new Cunard White Star cargo liner, "Arabia," and Richardsons-Westgarth-Doxford engines for three other ships. One of these ships was the "Rio Segundo," for the Argentine State Shipping Company, of Buenos Aires. The ship, of which we give an illustration, is of a specialised Burntisland Shipbuilding Company type, embodying the results of technical research. The hull form is distinguished by its fine line of shear, the well-raked, round-nosed stem, the flared bows and the cruiser stern. She has a length of 425ft, a beam of 57ft, and a depth to shelter deck of 37ft 9in, with a



Boiler for Orient Liner "Orcades"

loaded draught of 25ft 9¾in. The deadweight carrying capacity is 9450 tons, and the gross tonnage 4968. The "Rio Segundo" completed power and speed trials in the Firth of Forth in September last.

Returning to the Tyne, the Parsons Marine Steam Turbine Company, Ltd., of Wallsend, finished during 1947 main geared turbine machinery of 30,500 s.h.p., and also the manufacture of cut gearing for these installations, and in addition completed gearing aggregating over 16,100 s.h.p. for other marine engineering firms. A total of 53,375 s.h.p. of gearing was also cut by the company for other marine steam turbine installations.

At Wallsend, Hawthorn Leslie and Co., Ltd., completed four ships of 27,827 gross tons total, and built four sets of engines of 16,450 i.h.p.

At the Wallsend Slipway and Engineering Company, Ltd., at Wallsend, engines for the light fleet aircraft carrier "Albion," geared turbines for passenger and cargo vessels and Wallsend-Doxford engines were constructed, totalling 141,100 h.p. Oil-burning sets for marine and land installations were built, aggregating over 775,500 h.p., while, to meet the coal shortage, the Wallsend firm built 166 special oil-burners of the Wallsend-Summers pattern for oil-heated steel furnaces representing about 301,070 h.p. Repairs to eighteen ships and engines were carried out by the ship and engines repairing department, in addition to conversion work.

The output of Swan Hunter and Wigham Richardson, Ltd., of Wallsend shipyard, and Neptune Engine Works, Walker-on-Tyne, was outstanding on the North East coast for that firm launched twelve steamers, motor vessels and electrically propelled ships and the light fleet aircraft carrier, H.M.S. "Albion," aggregating over 107,622 gross tons. Machinery built totalled 25,900 i.h.p., and 5290 h.p., of Bauer-Wach exhaust turbines. Three troop-transport ships were converted and at the dry-docks department, sixty-four merchant ships of 528,657 gross tons and one warship of 2917 tons were docked and repaired, and four other merchant ships were repaired afloat.

In Sunderland, William Doxford and Sons, Ltd., built nine motor vessels aggregating 43,713 gross tons and completed fifteen sets of Doxford opposed piston oil engines in powers ranging from 3030 to 6120 i.h.p., totalling 68,956 i.h.p.

At Barrow-in-Furness, Vickers-Armstrongs launched three liners of 54,200 gross tons total and built steam turbines and oil engines for seven other ships, some of which were built at the Walker naval yard on the Tyne. Reference to some of these vessels was made in earlier articles.

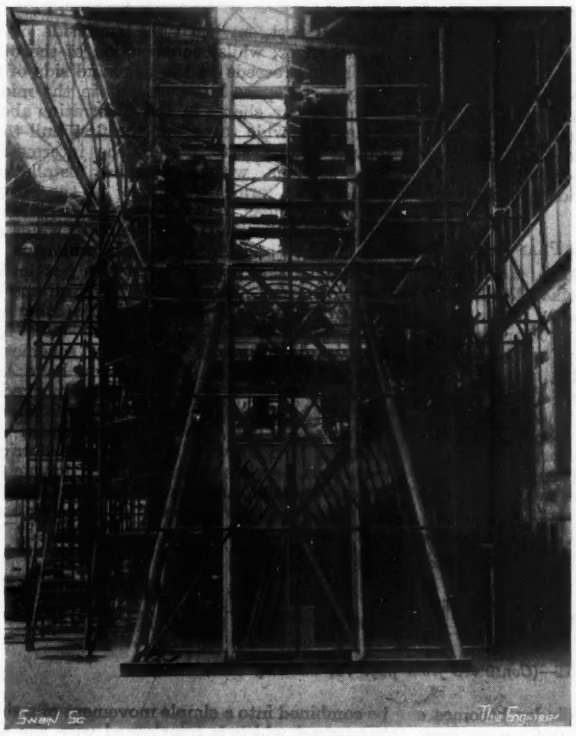
Special interest attaches to the machinery for the new Orient liner, "Orcades," which was launched during the year under review, and for which the propelling machinery is well in hand. It is designed to develop 42,500 s.h.p. and steam will be raised in two large and two small Foster Wheeler oil-fired water-tube boilers, at a pressure of 525 lb per square inch and a superheat temperature of 850 deg. Fah. We show in the accompanying engraving one of the two large boilers being transported from the Vickers boiler shops to the ship. The transport had to be carefully planned. The boiler, as shown, without its economiser and air heater, weighs 101 tons, while complete it will weigh over 160 tons. It has a designed capacity of 165,000 lb of steam per hour when burning 12,000 lb of fuel oil per hour, with an overall efficiency of about 88 per cent. The principal dimensions of the boiler are, height to top of preheater 40ft, width 27ft, and length 20ft. The total length of tubing in the boiler, with its economiser and air preheaters, is about 15 miles and the tubes are designed to evaporate 1½ tons of water per minute, giving steam for developing 17,000 s.h.p. The swivelled boiler fans with angled oil burners, now standard practice with naval and mercantile high duty boilers, should be noted.

The boiler we illustrate is probably the most powerful to be fitted to any British merchant ship up to the present time, and the installation of such large boilers has resulted in a valuable economy in boiler-room space.

The "S.R. 45" Flying Boat under Construction

FROM time to time we have referred in these columns to the design of the Saunders-Roe "S.R. 45" flying boat, the proposals for which were accepted by the Ministry of Supply in May, 1946. This great venture, by far the largest flying boat ever to be undertaken by the British aircraft industry, is scheduled for completion and initial flights in late 1949 or early 1950. It was accordingly with much interest that we recently paid a visit to the works of Saunders-Roe, Ltd., at Cowes and Osborne, Isle of Wight, where three of these machines are under construction.

Accompanying engravings illustrate the stage of construction at present reached on the hull of the flying boat. At first sight the reader may doubt whether the structure behind the immense network of scaffolding is really an aircraft at all, such is the complexity of jigs and framework necessary. But the bow and three-quarter views which are reproduced serve to give some idea of the shape of the hull when it is explained that the tail and fin assembly, some 34ft long, is to be built separately. Scale and proportions may be gauged by comparing the workpeople with the height of the hull and noting the four flights of steps. Of figure-eight section, the hull is arranged on two communicating decks with staircases for passengers and crew. All this space is pressurised, whilst below the lower deck floor is the planing bottom, divided into numerous watertight compartments, which is not pressurised. At the step station the overall height of the hull is 24ft 3in, whilst to the top of the fin the height will be 55ft 9in. For the completed aircraft the span will be 220ft and overall length 148ft.



UNCOMPLETED BOW STRUCTURE

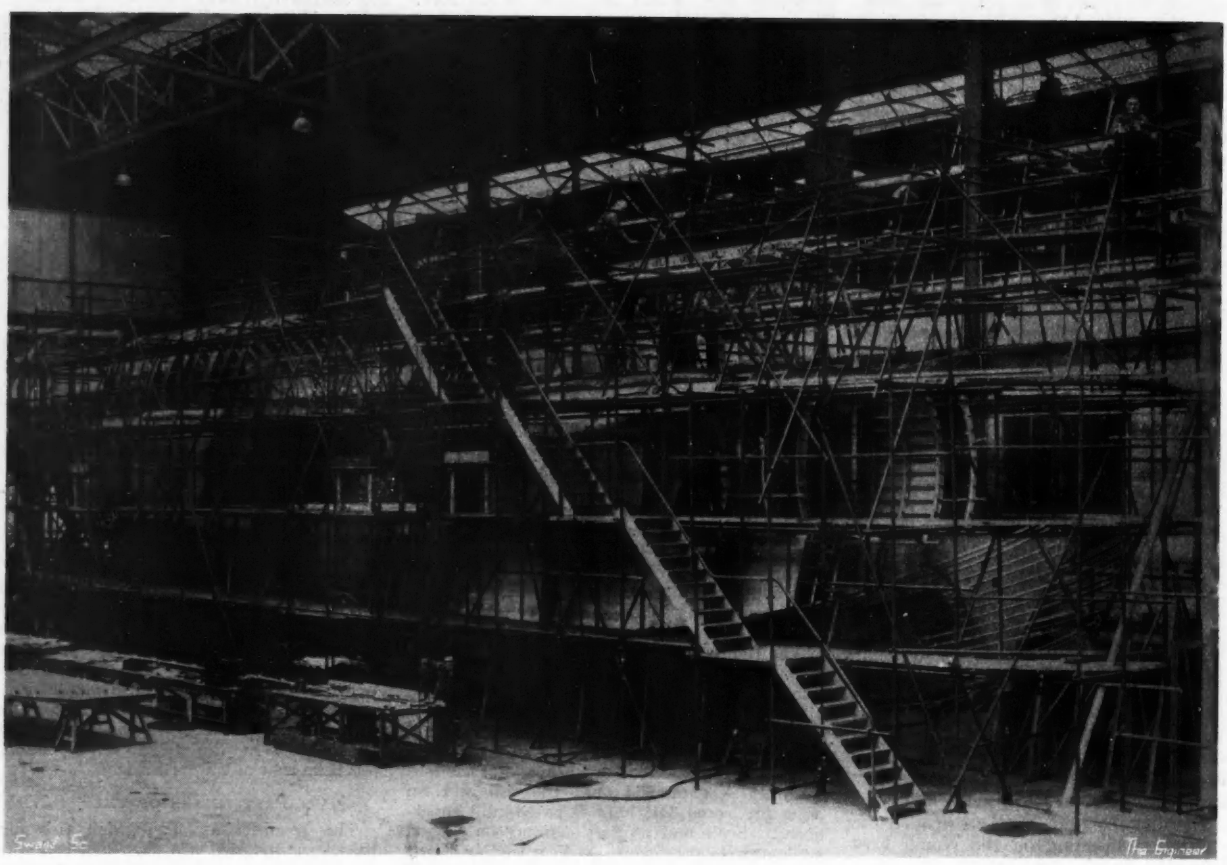
There has been considerable controversy as to the merits of large aircraft, such as the "Brabazon" and the "S.R.45," and also whether such machines should be land-based or water-based. It would seem, however, a great loss if the construction of either of these machines were stopped, for they bid fair to restore our temporarily lost prestige in civil aircraft operation. Certain of the arguments against flying boats are lessened as the size of the aircraft is increased. For example, additional drag due to a hull-shaped fuselage becomes progressively less and increase in structure weight due to the necessity for a robust planing bottom may be offset by heavy landing gear. In fact, we understand that the "S.R.45" structure weight is proportionately less than that of the "Brabazon."

Main Particulars of the "S.R.45"

The requirements for which this aircraft has been designed are that of medium, long and extreme range service in any part of the world, carrying 100–140 passengers and their baggage, according to the range. For the direct London - New York service, the range and speed available will be sufficient to allow for continuous head winds of up to 90 m.p.h. Its gross weight will be about 140 tons, cruising speed over 350 m.p.h., and range 5500 miles in still air. Ten gas turbine - propeller engines will give an aggregate power of 35,000 b.h.p.

A high-wing design with fully retractable wing-floats and single fin and rudder, the proportions are similar to those of many successful flying boats already built. The ten engines, which are to be Bristol "Proteus" units, similar to those to be used for the "Brabazon," will be mounted in a semi - buried position forward of the main spar in the form of self-contained units capable of rapid replacement. They will be disposed in six assemblies of which the two outboard will each have one engine unit driving directly a single propeller. The remaining four power plants will each comprise a pair of gas turbine engines, arranged side-by-side and geared together to a contra-rotating propeller system. The engine mountings will be attached to the front spar and engine nose ribs, with tailpipes emerging on the upper surface of the wing trailing edges.

CONSTRUCTION OF THE "S.R.45" FLYING BOAT



The hull, as already mentioned, is of figure-eight or "double-bubble" section, a construction which is of peculiar advantage in a large flying-boat which must be pressurised and air-conditioned. Passengers and payload are accommodated on two decks, the intersection of the upper and lower "bubbles" forming the floor of the upper deck, and the hull planing bottom being added to the lower "bubble."

The Construction Plan

At Cowes, Saunders-Roe, Ltd., is fortunate in having a large hangar in which the hulls of the first three machines are being built. Next door, in another hangar, the jigs for the wing sections are very nearly ready, and as already stated, situated there is the constructional equipment for the tail and fin assembly. Spacious as the main hangar is, the roof is not of sufficient height to allow the hull to have the tail unit attached within, nor can the outer wing sections be attached there. The wings are divided into five sections, two outer, two intermediate, and a central section.

For erection it has been decided to complete one hull first, on the right-hand side of the main hangar, whilst construction of the other two hulls proceeds on the left-hand side of the hangar. A space has been left in the middle of the hangar, shown in the illustration above, sufficiently wide to permit the first hull to be moved sideways to permit the intermediate wing sections, with the engine installations, to be fitted, prior to removal of the aircraft from the hangar. Once erection has gone this far, there will remain only the outer wings and tail units to be fitted, outside the hangar.

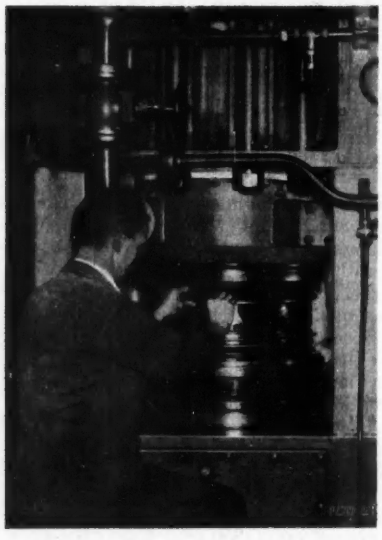
At the Osborne works the firm has built a complete mock-up in wood of the hull and has erected outdoors a test section of the hull, full-size, on which pressurisation tests have been made. Several alternative schemes of arrangement of the hull interior have been worked out; the arrangement mocked-up was notable for spaciousness and completeness of passenger and crew accommodation. No stooping is necessary in any of the corridors or saloons, or when walking up and down either of two staircases, and it would appear that when this great machine takes the air those on board will travel in a very luxurious manner.

The New Werkspoor-Lugt Engine

No. II—*(Continued from page 74, January 16th)*

IN the new engine every cylinder becomes a complete self-contained unit without the camshaft drive, the cams and the reversing gear. It is clear that the engine must have some element which determines whether it runs ahead or astern. This consists of a set of small auxiliary starting valves, operated by a short camshaft, which can be moved sideways in order to bring the ahead or astern cams into position. The sliding motion of this camshaft is entirely without load and it can therefore be hand-operated with ease. Thus all the manœuvring operations of the engine can be combined into a simple movement of a single handwheel which is interlocked with the telegraph reply lever. A view of the control panel is given opposite. Turning this handwheel from the centre stop position, the starting air camshaft is automatically set to the required ahead or astern position and the continued movement of the wheel brings the starting valves into action. Once the engine is running on starting air, the movement of the wheel in the same direction automatically brings the fuel pump into action, while the final movement adjusts the quantity of fuel needed for a certain speed. The manœuvring of the engine is, we found, therefore simple in the extreme.

In existing engines operating with straight-through scavenging there is, generally speaking, one large cylinder head with exhaust valves or one exhaust piston arranged in the axis



Renewal of Piston Rings

of the cylinder head. In order to operate these parts it is usual to provide a system of cams and levers or eccentrics, including heavy push rods and guides. As the placing of the exhaust valve or piston valve prevents the utilisation of the central position of the cylinder for the fuel valve, it is generally customary to place two fuel valves on opposite sides of the cylinder. In the Werkspoor-Lugt

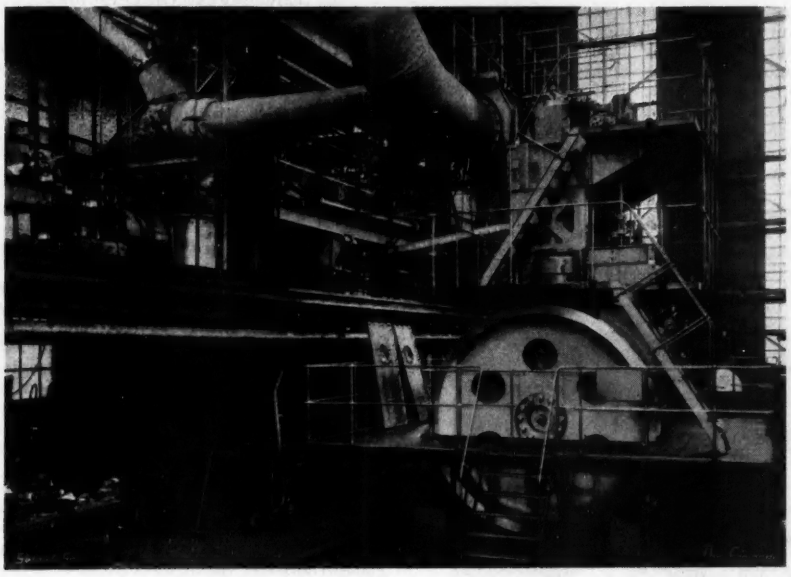
design, however, the fuel valve is placed in the centre of the cylinder head and the large exhaust valve is superseded by four small exhaust valves grouped around the centre fuel valve and having the same total area. A special valve motion is employed which, again, is derived from the up and down motion of the scavenge pump piston rod (a top view of the engine shows this mechanism). With this motion it is possible to move all four valves in two groups of two, by means of one pull-rod for each group of two valves. The two pull-rods are worked by one lever and the whole arrangement is lighter and smaller than that usually associated with push-rod operation. Moreover, the use of four small valves instead of one large one has another important advantage, namely, that at the moment of opening the area of the passage over the valve face is twice as much as with one big valve and therefore the first pressure drop in the cylinder takes place at a much higher speed. A second advantage is that the small valves require less maintenance than the large valves, being less liable to distortion and more easily ground in.

At the present time full details of the neat solution found for other movements required of the engine need not be discussed. It remains only necessary to draw attention to the means by which supercharging was made possible, giving thereby a larger quantity of combustion air to the cylinder and thus enabling an increase in power of about 30 per cent to be obtained. It is probable that this figure may later on be further increased.

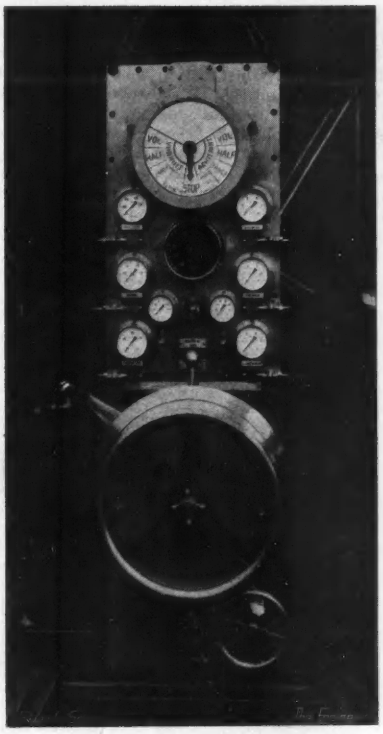
The mechanical efficiency of the experimental engine is remarkably high and will reach 88 per cent readily in a six-cylinder engine. The fuel consumption of the engine is well under 160 grammes or 0·35 lb per s.h.p.

The supercharger set, it can be stated, can be put anywhere in the engine-room and if need be in an isolated compartment. There is therefore no necessity for the rather special arrangements of exhaust piping which are peculiar to the usual four-stroke supercharging system operating with an exhaust gas turbine. Even an exhaust gas boiler can be introduced between the engine and turbo-compressor, an arrangement whereby it is possible to make use of the full exhaust gas temperature for steam raising duties. Another advantage of such an arrangement is that the air from the turbo-compressor can be cooled before it enters the scavenge air receiver thereby reducing the temperature in the receiver and lowering the temperature level of the entire cycle. Other types of rotary air compressors such as blowers can equally well be employed. Because of the excess of energy in the exhaust gases the engine can be made to work with a larger air surplus than usual, a fact which makes for lower temperatures and efficient cooling, notwithstanding that for the two-cycle engine a higher mean indicated pressure of about 110 lb per square inch is used.

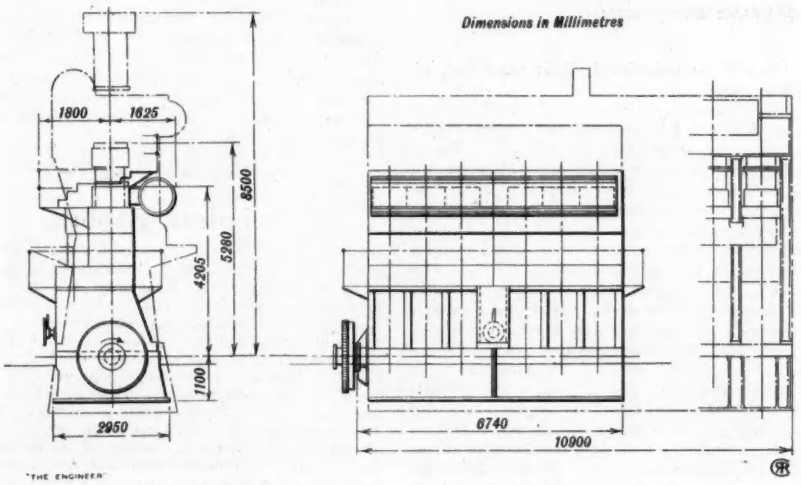
The experimental engine we are describing is a two-cylinder unit with cylinder diameter of 600mm, and a stroke of 1100mm. It is designed to develop, when supercharged, normally 600 s.h.p. per cylinder when operating at 130 r.p.m. A six-cylinder engine of this type will have a continuous output of 3600 s.h.p. equal to the output of the standard Werkspoor eight-cylinder engine with under-piston supercharging. The engraving herewith shows the gain in space made possible by the adoption of the new design. Even more attractive is the saving in



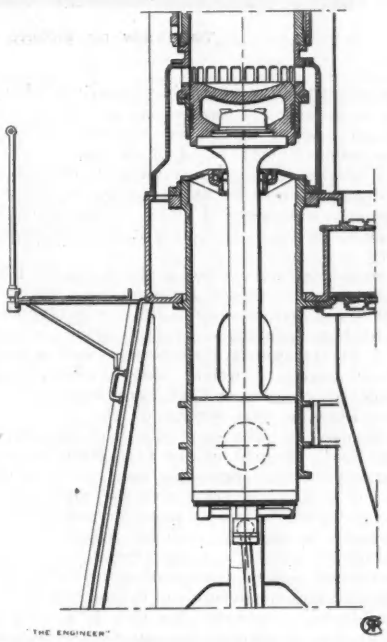
END VIEW OF ENGINE SHOWING EXHAUST GAS TURBO-BLOWER



CONTROL PANEL

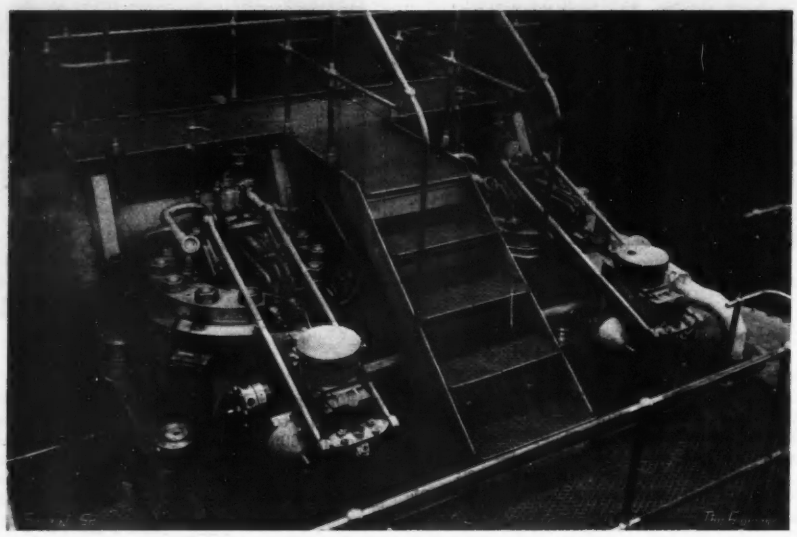


COMPARISON OF FOUR-STROKE WERKSPOOR AND TWO-STROKE WERKSPOOR-LUGT ENGINES



ARRANGEMENT OF ENGINE WITH LONGER PISTON ROD

weight. The old four-stroke engine weighs 315 tons, whereas the new two-cycle engine of equal power, including the turbo-compressor, does not exceed 140 tons or less than half the weight. Again, the fuel consumption of the new engine is about 10 per cent lower than that of the old one. The engine we have described may be termed a low-type crosshead engine, similar in design to that already made by Werkspoor for the well-known Dutch ocean-going tug, "Zwarte-Zee," and other installations. This construction has proved to be entirely satisfactory. If, however, it is desired to have a crosshead engine with a longer piston rod passing through a stuffing-box in the entablature, as shown in the accompanying drawing, this construction gives a higher engine and an increase in weight of about 15 tons. The new engine has also the advantage of requiring a very low height for cylinder dismantling, a dimension which is fixed by the height needed for a man to walk easily along the top platform. The piston is removed in the normal Werkspoor manner, namely, by providing a loose extension piece to the cylinder bottom, which, on being lowered



TOP VIEW OF ENGINE SHOWING VALVE MECHANISM

(as shown in the engraving herewith), allows for inspection and replacement of piston rings or, by unscrewing a small number of bolts, the complete withdrawal of the piston. The low height of the engine already referred to allows the lower decks in a ship to be continuous, whereas with most other types of engine a break in continuity is rendered necessary.

In conclusion, we may perhaps remark that the saving in weight obtained has not been due to the free use of light alloys or by adopting welded constructions, as both these sources give in themselves a relatively small saving. Some saving in weight has, however, been achieved by the evident care bestowed by Mr. Lugt on the design of the individual engine parts. The short length of the engine has been obtained in the first place by not putting the scavenging air compressor at the end of the engine but above the engine platform, and in the second place by reducing the distance between the cylinder centres to that minimum required by the use of a built-up crankshaft designed in accordance with Lloyd's Register Rules. In terms of cylinder diameter, the distance between the cylinders is 1·55 diameters, which gives enough room to accommodate the cylinder heads.

The Werkspoor-Lugt engine should make a valuable contribution to our post-war motorship construction programme, as it has already been thoroughly tested and is now ready for commercial installation. Another advantage is its capacity to utilise successfully the heavy Ordoil fuels experimented upon by Mr. John Lamb in the Anglo-Saxon Company's tanker, "Auricula," which experiments were fully described in a paper read before the Institution of Marine Engineers in December last. In the discussion to that paper Mr. Lugt was able to state that the new engine had run on the heavy oil fuel, and since the end of December longer runs have been reported.

"Tudor" Aircraft Enquiry

THE interim report of the Committee of Enquiry into the "Tudor" aircraft was published this week by H.M. Stationery Office. Commonly known as the Courtney Committee, from the name of Air Chief Marshal Sir Christopher L. Courtney, who heads it, the committee was appointed on November 27, 1947, by the Minister of Supply "to enquire into the development and production of 'Tudor' aircraft for the British Airways Corporations." The report is now published, together with the observations of H.M. Government thereon. It deals exclusively with the Avro "Tudor I." A further report on the other marks of "Tudor" aircraft will be submitted, it is expected, at an early date.

After summarising the history and nature of the "Tudor I" project, the report refers to delays in development and production. The production programme was affected by design changes and new requirements. In February, 1946, proposals for 357 modifications were made, 343 of them by B.O.A.C. During flight trials defects were discovered which proved more difficult to overcome than was at first hoped. The committee states, however, that although time could have been saved, it does not regard as excessive a period of about 2½ years from the start of design work to the issue of a full Certificate of Airworthiness. The committee feels that there is some justification for the firm's complaints on the score of successive changes called for by B.O.A.C. In a commentary on the delays, the root cause of the trouble is stated to have lain in defective co-operation between user and producer where there should have been concentration on getting the aircraft into service as soon as possible. There was such an effective division of constitutional responsibility among the organisations concerned that each could find unimpeachable reasons for keeping its constructive activity within moderate limits, and on none of the parties was there such clear financial responsibility as would have impelled action. None the less, the report adds, effective leadership *could* have come from either of the two departments, but for reasons which doubtless seemed good at the time, it did not.

Amongst the conclusions and recommendations the committee agrees that the operation of the "Tudor" on the North Atlantic would be conducted at a substantial loss. But that had always been a feature of the project and would be justified by the experience to be gained both by operators and constructors. It goes on to recommend the starting in the national interest of services across the Atlantic as soon as a Certificate of Airworthiness is reissued, provided the original specification performance is realised.

GOVERNMENT OBSERVATIONS

The report relates to events occurring between 1943 and the summer of 1947. Some of the points criticised by the committee were the result of wartime conditions and in the early stages the general development of the project was affected by the necessary preoccupation of all concerned with military requirements. The criticisms made of B.O.A.C.'s internal organisation and their relations with the constructors also relate mainly to a period when the Corporation's organisation was on a wartime basis or in transition to a peacetime basis.

A number of changes have been made in the organisation of the Corporation with a view to increasing its efficiency. The procedure for the ordering of aircraft was altered as long ago as September, 1946, and in contracts placed since that date the Corporations take full financial responsibility for the aircraft ordered to meet their stated requirements. In addition, the Civil Aircraft Requirements Committee, of which Sir Henry Self was first chairman, was formed in 1946. This committee consists of representatives of the Ministries of Civil Aviation and Supply, the Treasury and the three Airways Corporations and associates the latter, from the inception, with the responsibility for formulating the requirements and performance specifications of new aircraft types. The present organisation is, therefore, more satisfactory than that disclosed in the Report, but the Government are, nevertheless, endeavouring to improve it.

A "Tudor I" aircraft, incorporating a number of improvements found to be desirable during the development of the type, is due to undergo its final trials in the next few weeks. Discussions are now proceeding with B.O.A.C. on the basis that, if these trials show that the type meets the specifications originally laid down and a Certificate of Airworthiness is granted, the "Tudor I," suitably modified as regards seating accommodation, will be brought into service as may best fit in with the programme of development of the Corporation's services. The aircraft will be purchased by the Corporation and no special subsidy will be paid outside the provisions of the Civil Aviation Act, 1946.

Technical Reports

The Grading of Aggregates and the Workability of Concrete: Road Research Technical Paper No. 5. H.M. Stationery Office, Kingsway, W.C.2. Price 1s. 8d. post free.—This report was first published in 1938, but has now, in this second edition, been enlarged and slightly amended. The report describes an investigation into the effect of the ingredients on the properties of concrete; it deals especially with the relations between mix proportions, aggregate shape and grading and workability. The main part consists of an examination of the effects of the shape and grading of the aggregate and of the mix proportions on the workability of concrete. It is shown that while the water-cement ratio is the chief factor that determines the strength of concrete, the water-cement ratio in a given mix is itself largely determined by the grading and type of the aggregate used. Workability is more precisely defined in this report and is regarded as a property of the concrete alone. A description is given of a method of measuring workability, called the "compacting factor" test, which overcomes some of the limitations of the slump test.

For the practising engineer the paper provides a good background of knowledge on designing concrete mixes having specified properties. This subject will, however, be dealt with more fully in "Road Note No. 4—The Design of Concrete Mixes," which will be published in two to three months' time.

Metropolitan Water Board

WORKS IN PROGRESS AND CONSTRUCTED DURING 1947

IN our Civil Engineering annual review article it was possible only to refer very briefly to one or two items of the Metropolitan Water Board's programme of works. Below we summarise the progress during 1947 of the main works being undertaken by the Board.

Ashford Common.—The construction of a new filtration works and pumping station on land east of Queen Mary reservoir, together with the laying of two mains to convey the filtered water into supply, has been approved by the Board. The output of the station when completed will be 90 m.g.d. The water-treatment plant includes aeration basins, a battery of micro-screens instead of primary filters, and slow sand beds, thirty-two in number, each about ¾ acre in area.

The Ministry of Health authorised the first stage of the work, general excavation and soil stabilisation, being commenced on September 15, 1947, and a further authorisation has been given for the construction of sixteen slow sand filters, a contact tank, a pumping station and ancillary works.

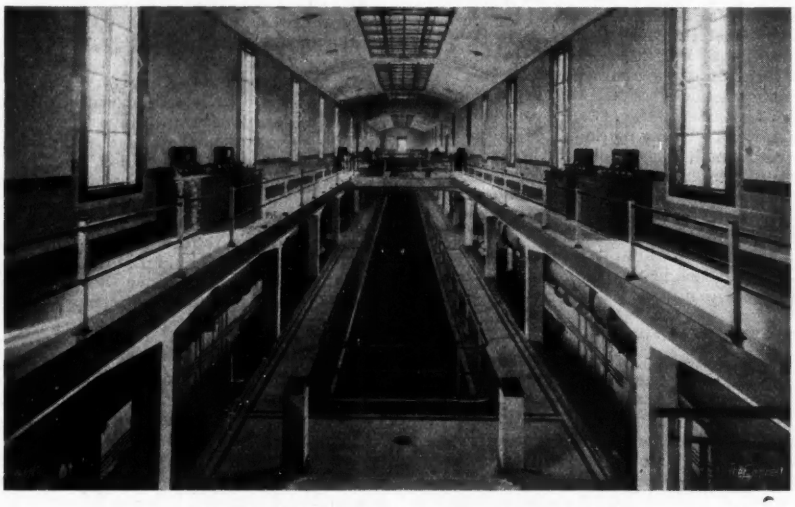
The pumping machinery will consist of electrically driven low-lift and high-lift pumps. A complete source of power for standby and peak load relieving will be provided by three diesel alternators and two gas turbine alternators. Three 1700 h.p. diesel alternators have been purchased ex-war stock for this purpose.

Chingford.—Progress in connection with the construction of Chingford No. 2 reservoir was seriously retarded during the war period, and since then the work has proceeded slowly due to the continuance of stringent conditions. The reservoir when completed will have a capacity of 3180 million gallons, and is the last of the storage reservoirs which can be built in the Lee Valley.

Fortis Green.—The demand on this station has progressively increased during the last few years to such an extent that six out of the seven diesel-driven units are at times in service. The standby margin is therefore insufficient to safeguard the supply. The installation of electrically driven centrifugal pumps in an extension to the existing house has therefore been approved, and when completed the capacity at this station will be increased by 13 m.g.d. The electric units will be used to take the normal load and the diesel-driven sets for peak load relief and standby duties.

Hadley Road.—The Board's policy of substituting electric drive for steam in the case of small isolated supplies is exemplified at Hadley Road, where the triple-expansion engine (much underloaded on account of poor yield of well) has been removed and temporary pumps, driven by purchased electric power, installed. Inquiries have been issued for permanent electrically driven pumps, both for main service and also local high-level service, which is temporarily still steam driven. Two diesel alternators purchased by the Board ex-war stock are being installed for standby peak load relieving purposes.

Hampton.—Thames-derived water is filtered and pumped into supply at these works, which date from 1852, and are the largest operated by the Board. In order to increase the capacity of the station from about 55 m.g.d. to 120 m.g.d., a large scheme of remodelling, comprising mainly new machinery and the installation of primary filters, was commenced shortly before the war.



CONTROL HOUSE, HAMPTON PRIMARY FILTERS

The new engine-house was finished and the machinery in it set to work before the outbreak of hostilities, but the remainder of the scheme was seriously delayed during the war period.

The primary filters, illustrated herewith, have been completed, as well as the major part of the laying of the new conduits and mains necessary for incorporating the new works into the existing station.

The construction of the 11·3 million-gallon balancing and contact reservoir and the erection of the screening apparatus is nearing completion. The contractors for the reservoir are William Moss and Sons, Ltd., and the screening apparatus is being supplied by Guest and Chrimes, Ltd.

A 54in. raw water conduit of welded steel shells ¼in thick (⅜in on bends) is being constructed for increasing the supply of raw water from Queen Mary and Staines reservoirs to the primary filters. About 900 lineal yards of conduit have been laid out of a total length of 1000 yards, and the interior of some 470 yards of the conduit has been lined with Gunite. The steel shells were supplied by Horseley Bridge and Thomas Piggott, Ltd., and the civil engineering work is being carried out by William Moss and Sons, Ltd.

CONCRETE FLOOR FOR CONTACT TANK AT LEE BRIDGE WORKS

Kempton Park.—It will be remembered from our issue of January 3, 1947, that two new steam-raising plants totalling 30,000 lb per hour normal capacity had been ordered from John Thompson Water Tube Boilers, Ltd. Manufacture is now well advanced, and installation will be put in hand shortly.

The provision and installation of four automatic self-cleaning experimental rotary strainers by Glenfield and Kennedy, Ltd., has been completed apart from the fixing of the rate of flow recorder.

The Candy Filter Company, Ltd., and the Paterson Engineering Company, Ltd., are installing two experimental purification plants, each of a nominal capacity of 1 m.g.d., on a site adjoining the main works. Site work has been commenced by the first-named company.

Lee Bridge.—The interim scheme for reconstruction of this station is progressing. Most of the adaptations, namely, the modification of the Fowler diesel d.c. generators from mobile to stationary use, of a number of A.R.P. pumps for modified duty, and of the A.R.P. rectifiers for 400V instead of 200V, are now well in hand.

An engine and pump-house for the new plant is being constructed by F. R. Hipperson and Son, Ltd. Excavation work has been completed, and concreting to the foundations is in progress.

Staines.—The new reservoir was inaugurated by His Majesty King George VI, accompanied by Her Majesty the Queen on November 7, 1947, and named the "King George VI" reservoir. A full description appeared in our issue of November 14, 1947.

General.—The main objects which the Board has in view are, first, the provision of additional filtration works adequate to cope with the greatly increased, and rapidly increasing, demand for water, and secondly, the construction of further storage reservoirs not only to provide for an increased filtration capacity, but also to rectify a shortage of storage which already exists. There is also the necessity to replace on a considerable scale obsolete steam-driven plant at many places. In general, this is being accomplished by the installation of pumps normally driven by purchased electricity, reinforced by diesel-driven alternators.

Industrial and Labour Notes

Employment and Unemployment

The latest report by the Ministry of Labour on the employment situation in Great Britain shows that there was a slight increase in November in the total working population, which, at the end of that month, numbered 20,452,000. It is estimated, however, that since June, 1945, the total working population has declined by 1,197,000 (256,000 men and 961,000 women).

The total number of people in civil employment at the end of November was 18,905,000 (13,225,000 men and 5,680,000 women), which indicates that there was an increase of 44,000 during the month, compared with 94,000 in October. The Ministry of Labour makes the additional observation that the rate of increase in civil employment in November fell slightly below the average increase during the first nine months of last year. The distribution between industries of the increase in civil employment during November, however, revealed a greater degree of concentration upon those industries most in need of additional labour. There was, for instance, an increase of 17,000 in the labour force of the metal, engineering and shipbuilding industries, which included an addition of 900 in general iron-founding, and employment in mining and quarrying also increased by 2000 compared with a decline of 1000 in October. On the other hand, the labour force of the building and civil engineering industry was decreased by 10,000 during November. In the manufacturing industries generally, it is estimated that at the end of November 1,911,000 people were engaged in producing goods for export and 5,002,000 people were working on manufactures for the home market.

Unemployment statistics issued last week by the Ministry of Labour show that on December 8th there were 277,245 insured persons on the registers compared with 267,785 on November 10th. The December figures included 199,652 men between the ages of eighteen and sixty-four, 7,702 ex-Service personnel, who had had no employment since leaving the forces, and 36,329 married women. In addition, there were 11,270 uninsured persons on the unemployment registers on December 8th, a figure which included 1221 boys and girls under eighteen who had not then entered industry.

Iron and Steel Production

The December production figures for the iron and steel industry, which were issued at the end of last week, show that the month's output of pig iron averaged 164,600 tons a week, which represented an annual production rate of 8,561,000 tons. In the preceding month, pig iron production was at an annual rate of 8,617,000 tons and during the fourth quarter of 1947 the annual production rate was running at 8,505,000 tons. The year's output of pig iron was 7,785,000 tons, compared with 7,761,000 tons in 1946.

The production of steel ingots and castings in December averaged 243,200 tons weekly, or an annual rate of 12,646,000 tons, an output which reflects the influence of the Christmas and New Year holidays. The annual rate of steel output in November was 14,174,000 tons and over the whole of the fourth quarter of last year was 13,679,000 tons, compared with 11,231,000 tons in the first quarter. In the fifty-two weeks ended December 27, 1947, total production of steel reached 12,515,000 tons, and had by then exceeded the year's target of 12,500,000 tons. In the full year—fifty-three weeks ended January 3rd—production amounted to 12,724,000 tons, compared with an output of 12,693,000 tons in 1946.

In presenting these figures, the British Iron and Steel Federation observes that even in the fourth quarter of 1947, raw material supplies were not coming forward at a rate sufficient to maintain the current level of output which was achieved only by drawing on stocks. Coke shortage limited pig-iron production to an annual rate of 8,505,000 tons, compared with a requirement of over 9,000,000 tons needed to maintain steel output at 14,000,000 ingot tons.

A Progressive Spirit in Industry

In a statement circulated with the annual report of Barclay's Bank, Ltd., the chairman, Sir William Goodenough, stresses amongst other matters, the need for what he calls a progressive spirit in this country's industrial development. We can see all too clearly, he says, how intense a degree of competition will eventually develop in world markets, and it can also be seen that the growth of manufacture abroad will continue as the relatively undeveloped countries seek the added stability and higher living standards that they see in the possession of secondary industries. At a time not far distant therefore, Sir William argues, we must be ready for the disappearance of the outlet for some of the products which we have hitherto supplied in large quantities.

Apart from showing how much our prosperity depends upon a growing volume of international trade in the future, Sir William suggests that present trends indicate that our industrial development must move towards a greater diversity than has been the case in the past, so as to become more broadly based and hence less vulnerable. Industrial development must also, he says, be encouraged to sustain a strong progressive spirit so that we may advance rapidly and freely to the initiation and exploitation of new inventions and new techniques. In the war, Sir William observes, we were unrivalled in the field of scientific invention, and it is vital to us that here this country should be and should remain in the lead.

The British Export Trade Research Organisation

The British Export Trade Research Organisation is now completing its second year of full activity, and reports that the work which it has on hand at present shows an increase of approximately 300 per cent when compared with the volume of work undertaken nine months ago. The Director of B.E.T.R.O., Lieut.-Colonel H. A. P. Disney, says that the organisation's activities began to increase greatly in the early summer of last year with the announcement of import restrictions in many overseas markets and the complete closing down of some markets. Manufacturers large and small, Lieut.-Colonel Disney reports, began to recognise more fully the necessity for market research, and the subsequent publication of the results of the Geneva Tariff Conference brought to the organisation further requests for up-to-date information about the changed conditions under which British goods could in future be exported.

Allocations of Tin Metal

The Ministry of Supply has announced the interim allocations of tin metal made by the Combined Tin Committee for the first half of 1948, amounting in all to 17,703 long tons. The allocations made represent more than half of the total allocation that each country can expect for the first six months of this year, in view of the estimated production of tin metal available for export up to June 30, 1948, and after taking into account the probable requirements of many countries which have not yet been presented to the Committee. When this information has been supplied, allocations will be made to such countries on the basis of the same standards used in computing the allocations which have now been published.

The committee regrets that the supplies of tin metal available for allocation during the first six months of 1948 will fall short of the amount available during the last half of 1947, mainly because all the wartime stock-accumulations found in the Far East have been distributed. A revised questionnaire calling for final data for the second half of 1947 is being forwarded very shortly to representatives of consuming countries. Replies are expected by March 1st to enable the committee to make final allocations for the first half of 1948 later in that month.

The first interim allocations for 1948 are as follows: Canada, 1090 tons; Chile, 32 tons; Czechoslovakia, 336 tons; Denmark, 160 tons; Finland, 60 tons; France, 2720 tons; Germany (U.S.-U.K. Zone), 324 tons; Germany (French Zone), 120 tons; Hong Kong, 100 tons; India, 1400 tons; New Zealand, 146 tons; Palestine, 55 tons; Poland, 520 tons; Switzerland, 200 tons; Turkey, 140 tons; U.S.A., 10,200 tons, and others, 100 tons.

Science and Industry

Speaking on the subject of Government, Science and Industry, on Wednesday of last week, at Letchworth, the Lord President of the Council, Mr. Herbert Morrison, said that he was glad to notice the interest taken by trade union leaders in the work undertaken by the research associations of their own industries. Those research associations were organisations set up by industry and Government in co-operation, and he thought it was a healthy sign that workers should be taking an interest in their doings. Mr. Morrison went on to express the hope that such interest would spread so that it permeated all the industries of the country.

Operational research, the Lord President remarked, which gave managers a yardstick for measuring the effects of operations under their control, was not entirely new to industry. Under various names, it had its successes in industry prior to the war; but under war conditions it was developed and added to its practice of applied statistics new methods of scientific logic, so that to-day it could be applied with great benefit immediately to many important sections of our economic life. The continued use and development of that important practical scientific contribution to production and industrial efficiency would be encouraged by the Government.

Mr. Morrison also announced that the Government had decided that the new town at Stevenage would be given preference in considering the sites of new scientific establishments in the London region. This was an important matter, he said, because a number of research stations would have to move from present sites which they had outgrown. In future, Mr. Morrison concluded, we must get used to setting aside for science bigger resources and more manpower if we were to get the maximum result. It was important that scientific research and the refreshment and inspiration which it brought should be well distributed over the country, but at the same time many of the research establishments must of necessity be in the London region.

British Overseas Trade

Exports of United Kingdom goods during the month of December reached a total value of £110,200,000, compared with a value of £102,253,000 in November. The December figure was only £50,000 below the peak achieved in July of last year. Allowing for the rise in prices, the December exports by volume are estimated to have been 120 per cent of the 1938 average, compared with 112 per cent in November and 126 per cent in July. December was, of course, a shorter working month, but exports for each working day was actually about 8½ per cent higher than in July, although it is pointed out that they were influenced to some extent by the Christmas parcels post.

Imports in December were valued at £153,400,000, against £138,164,000 in November. As, during December, the rise in the value of imports was a good deal greater than that of exports, the adverse balance of trade increased to £39,200,000. In November the adverse balance was £31,900,000.

French Engineering News

(From our French Correspondent)

Considerable flood damage has been sustained in industry in the east of France. Even when the floods subside it will not be possible to resume production immediately. Equipment will have deteriorated and in some cases raw materials ruined. Communications will also be difficult because many bridges, either temporary or under construction, have been damaged. The railway line was cut in several places, but passenger traffic has now been restored. At Pompey the water completely covered installations of the Société des Hauts Fourneaux, including motors and transformers.

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Credits for the maintenance of French highways are being reduced this year. In 1947 twelve milliard francs were devoted for this purpose, whereas this year the sum will be reduced, although prices have risen from 30 per cent to 40 per cent. Work now in progress will not be completed. The auto-road to the west will have to be stopped.

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Monsieur Robert Lacoste, Minister of Industrial Production, inaugurated the Génissiat hydro-electric scheme on January 19th. It will take about two months to fill the reservoir and electricity production is expected to start sometime in March.

Under the Monnet Plan, by 1951 sixty new hydro-electric plants will have come into operation, increasing annual production from 20,000 million kWh to 39,000 million kWh. The plan may, of course, be modified by the financial situation.

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Under the Mayer Plan many classes of industrial goods have been freed from price control. Among them is equipment for the foundry industry and the machine tool industry. Leaders in the industries have pointed out that the Minister of Industrial Production can reimpose controls if he considers them necessary, and have asked all concerned not to exaggerate price increases.

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The "Guillotine Committee," set up by the government to reduce expenditure, has advised the closing of the General Commissariat for Saving Materials. This body advised industry on how raw materials might be saved and its closing has been badly received by industry as a whole. Nevertheless, the agitation which followed the demise of the Commissariat resulted in the formation of a series of schools run locally to teach saving methods. In Lyons, a boilermen's school, holding two classes a week, succeeded in teaching 170 boilermen in the area how to save coal. Economies now amount to about 15 per cent. Other schools are to be opened in Paris, Lille and Marseilles.

The Ministry of Industrial Production, now responsible for raw materials, hopes to save the country between 19,000,000 and 20,000,000 tons of coal a year. This will be done by widespread propaganda and the opening of economy schools.

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Users of propane gas are complaining that deliveries have stopped and their production programmes are being held up. The gas is only delivered to industry. It is hoped that in 1948 the situation will improve, for the real cause of the problem is lack of containers. Further, the refineries on the Mediterranean are badly equipped and cannot fill the 10 kilos and 35 kilos containers which are most popular. The gas has, therefore, to be carried from the south in tanks as far as Rouen, where it is distributed to containers at the Petit-Couronne installation, which was not destroyed during the war.

The manufacture of containers is to be pushed ahead in order to speed up gas deliveries. It has not as yet been decided whether the refineries shall be equipped with distributing devices to serve the containers. If this could be done a great deal of time would be saved.

Notes and Memoranda

Rail and Road

BIGGER RAILWAY TURNTABLES.—In order to enable larger locomotives to be turned, modern turntables of greater size are to be installed on the London Midland region of British Railways at Belle Vue (Manchester), Bournville (near Birmingham), and Llandovery (Carmarthenshire). At Belle Vue and Bournville the diameter of the new turntables will be 57ft and at Llandovery 65ft.

NEW ESCALATOR AT CHANCERY LANE STATION.—London Transport states that work has started on the construction of a new escalator at Chancery Lane (Central Line) Underground Station. It will be reversible, 121ft long, capable of travelling at 165ft per minute, and of moving 10,000 passengers an hour. The new escalator will be placed between the two present ones at the station, and its direction will be changed according to traffic flows, with the object of speeding up peak hour traffic at the station. It is hoped that it will be brought into service during August.

AMERICAN RAILWAY RECEIPTS.—According to the Association of American Railroads, the estimated net income of Class I railways in the U.S.A. during the first ten months of 1947 was, after deduction for interest and rentals, 364 million dollars. In the corresponding ten months of 1946, the income totalled 162 million dollars. The Association adds, however, that comparisons of railway earnings for 1947 with those of 1946 should take into account the fact that the first six months of 1946 included a period of industrial disturbances, work stoppages and railway wage increases and for those reasons receipts were abnormally low.

L.M.S. COMPANY'S ASSETS IN NORTHERN IRELAND.—Preliminary discussions have taken place recently regarding the acquisition from the British Transport Commission of the Northern Ireland assets of the London, Midland and Scottish Railway (Northern Counties Committee). Broad principles governing the transfer have been considered, and when these are established, technical talks will follow. It is reported that if the negotiations are successful, the assets referred to will ultimately vest in the new Northern Ireland Transport Authority, which is to be set up to co-ordinate road and rail transport. Proposals for the establishment of this authority will be laid before the Northern Ireland Parliament in due course.

THE PREVENTION OF DAZZLE ON ROADS.—The Road Research Laboratory of the Department of Scientific and Industrial Research has recently completed a survey of the prevalence of dazzle and of driving behaviour in connection with the dipping of headlamps. It was found that dazzle is common, but that only about one-quarter of the cases of dazzle are caused by drivers who leave their headlamps full on. Most of the dazzle is due to dipped headlamps and passlamps, the low-mounted passlamp being especially liable to cause dazzle. It is recommended that lamps should be set so that driving beams do not rise above the horizontal and passing beams are dipped at least 3 deg. It is also recommended that headlamps and passlamps should be mounted not higher than 3ft 6in and preferably not lower than 2ft 6in, but in any case not less than 2ft, from the ground. These are proposals for dealing with existing vehicles in order to alleviate the dazzle situation in the immediate future. No discussion is attempted in the survey of possible measures for obtaining a more permanent and satisfactory solution, although research is being carried out to this end.

Miscellanea

THE LATE MR. V. GARTSIDE.—We have heard with regret of the death, on December 11th last, of Mr. Vincent Gartside, manager of the London office of John Holroyd and Co., Ltd. He had been in the firm's service for fifty years.

"THE MODEL ENGINEER."—We offer our hearty congratulations to the *Model Engineer* on the attainment of its fiftieth birthday. It celebrated the event by appearing on January 1st in a new cover and by the inclusion of an autobiographical article by its founder and editor, Mr. Percival Marshall. Mr. Marshall, who had the regular training of an engineer, not only felt in himself the charm of technical models, but noted that that was a feeling shared with a great many people. Hence the idea occurred to him that a periodical devoted primarily to technical models should win a public. No paper of the kind existed and even experts doubted that one would ever have a worth-while circulation. But Percival Marshall at that time had gravitated into the publishing business, and he saw possibilities that the outsider could not see. So he made his venture and just half a century ago came out with his first number. It was a greater success than he expected, and it has continued to be successful to this day. That is because, we suggest, it took itself seriously from the start. It recognised model-making as a genuine form of engineering, and it treated the model engineer's workshop with the respect it merits. The *Model Engineer*, under Mr. Marshall's skilful guidance, soon became the recognised organ of the craft of model-making. It has held its position for half a century. May it attain its century with no abatement of its energy and usefulness.

HOW PAINT HELPS EXPORTS.—A display, "How Paint Helps Exports," which is designed to assist industrialists in "regrooming" their products for export markets, will be opened by Mr. A. G. Bottomley, Secretary for Overseas Trade," at the Charing Cross Hotel, London, on Monday next, January 26th. This display is being presented by the Paints Division of Imperial Chemical Industries, Ltd., and its object is to illustrate how modern finishing techniques can impart sales appeal and protection to the product at low cost. A new thirty-five-minute sound film in colour, "The Technique of Spray Painting," will show some of the methods in operation. The display will be open from January 26th to 31st, between 11 a.m. and 6 p.m.

IMPORT OF MACHINERY.—Under Section 10 of the Finance Act, 1932, as amended, the Treasury is empowered, after consultation with the Board of Trade, to license the duty-free importation of machinery. It is a statutory requirement that application for the issue of a licence under the section should be made before the machinery is imported. The Board of Trade says that cases continually arise in which application is made for a Treasury licence after the consignment of machinery has reached the United Kingdom. Whatever the merits of the case for duty-free importation, it is not possible under the statutory provisions for a Treasury licence to be granted in such circumstances. Importers should accordingly note that, in the case of any machinery which it is desired to import free of duty, it is essential, in order that the application for exemption from duty may be considered, that it should be made before the machinery reaches the United Kingdom. The application can then be considered on its merits.

FIRST DIRECTOR OF RADIO RESEARCH.—The Lord President of the Council has approved the promotion of Dr. R. L. Smith-Rose, D.Sc., Ph.D., M.I.E.E., to the new post of Director of Radio Research in the Department of Scientific and Industrial Research. He will take charge of the radio research work of the Department for which a new station will eventually be established. The new station will incorporate the work now being carried out in the Radio Division of the National Physical Laboratory, and the Radio Research Station, D.S.I.R., at Slough, and also work at present being done for D.S.I.R. at the Telecommunications Research Establishment at Malvern. Dr. Smith-Rose, who is fifty-three, has been Superintendent of the Radio Division of the National Physical Laboratory since 1939. He has been responsible for conducting extensive investigations in radio direction finding, the electrical properties of soil and sea water, and the propagation of radio waves over the ground and through the lower atmosphere.

GENERATION OF ELECTRICITY, DECEMBER, 1947.—The Electricity Commissioners state that 4432 million units of electricity were generated by authorised undertakers in Great Britain during the month of December, 1947, as compared with the revised figure of 4372 million units in the corresponding month of 1946, representing an increase of 60 million units, or 1·4 per cent. During the twelve months ending December 31, 1947, the total number of units generated by authorised undertakers was 42,579 million units, as compared with the revised figure of 41,254 million units for the corresponding period of 1946, representing a increase of 1325 million units, or 3·2 per cent. The total number of units sent out from the generating stations of authorised undertakers during the month of December, 1947 (i.e., units generated less units consumed in the stations by auxiliary plant and for lighting, &c.), was 4190 million units, as compared with the revised figure of 4140 million units in the corresponding month of 1946, representing an increase of 50 million units, or 1·2 per cent. During 1947, the total number of units sent out from the generating stations of authorised undertakers was 40,173 million units, as compared with the revised figure of 38,934 million units for 1946, representing an increase of 1239 million units, or 3·2 per cent.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

Association of Supervising Electrical Engineers

Saturday, Jan. 24th.—OXFORD BRANCH: Electricity Department's Demonstration Room, George Street, Oxford. "Motor Control Gear," R. Mathieson. 3 p.m.

Monday, Jan. 26th.—BOURNEMOUTH BRANCH: Wedgwood Restaurant, Albert Road, Bournemouth. "Single to Three-Phase Conversion Systems," A. N. D. Kerr. 7.45 p.m.

Tuesday, Jan. 27th.—NORTH WEST LONDON BRANCH: St. Hilda's Hall, South Harrow. "Power Factor Improvement," W. Gearing. 7.45 p.m.

Chemical Society

To-day, Jan. 23rd.—University College, Southampton. "Synthetic Organic Chemistry in Relation to Biology," E. C. Dodds. 5 p.m.

Thursday, Jan. 29th.—Engineers' Club, Albert Square, Manchester. "Nitration by Mixtures of Nitric and Sulphuric Acids," G. M. Bennett. 7 p.m.—University College of North Wales, Bangor, "Reactions of the Ethylene Bond," D. H. Hey. 5.30 p.m.—The University, Sheffield. "Stereochemical Regularities in Catalytic Reactions," R. P. Linstead. 5.30 p.m.

Friday, Jan. 30th.—Birmingham: The University, Edgbaston. "Recent Developments in the Application of Infra-Red Spectroscopy to Chemical Problems," G. B. B. M. Sutherland. 4.30 p.m.

Hull Chemical and Engineering Society

Tuesday, Jan. 27th.—Church Institute, Albion Street, Hull. "They're Everywhere," Film by Guest, Keen and Nettlefolds, Ltd. 7.30 p.m.

Incorporated Plant Engineers

Monday, Jan. 26th.—LEEDS BRANCH: The University, Leeds. "The Analysis of Diesels," E. Hill. 7.30 p.m.

Friday, Jan. 30th.—LONDON BRANCH: Criterion Restaurant, Piccadilly, W.1. Annual General Meeting. 7.45 p.m.

Institute of British Foundrymen

Saturday, Jan. 24th.—BRISTOL AND WEST OF ENGLAND BRANCH: Grand Hotel, Broad Street. Bristol. "Bronze Castings," J. L. Howard. 3 p.m.

Institute of Marine Engineers

Wednesday, Jan. 28th.—JUNIOR SECTION: College of Technology, Belfast. "Gas Turbines," C. C. Pounder. 7.30 p.m.

Friday, Jan. 30th.—JUNIOR SECTION: Technical Institute, Falmouth. "The Combustion Turbine," J. Calderwood. 7.15 p.m.

Institute of Metals

To-day, Jan. 23rd.—SHEFFIELD SECTION: Royal Victoria Hotel, Sheffield. "Some Metallurgical Problems in the Field of Atomic Energy," E. W. Colbeck. 6.15 p.m.

Institute of Welding

Wednesday, Jan. 28th.—Institution of Civil Engineers, Great George Street, S.W.1. "(1) The Evolution of Welded Components in House Construction; (2) Welded Bunkers in Power Houses," J. Corston Mackain. 6 p.m.

Institution of Civil Engineers

Tuesday, Jan. 27th.—Great George Street, S.W.1. "Design, Installation and Maintenance of Long Welded Rails," C. E. Dunton and Keith Brinsmead. 5.30 p.m.

Institution of Electrical Engineers

To-day, Jan. 23rd.—LONDON STUDENTS' SECTION: Visit to *The Daily Telegraph*, Fleet Street, E.C. 8.45 to 10.45 p.m.—N.E. STUDENTS' SECTION: Grey Hall, King's College, Newcastle upon Tyne. "H.V. Oscillograph," W. K. Harrison. 7 p.m.

Saturday, Jan. 24th.—LONDON STUDENTS' SECTION: Visit to E.M.I. Studios, Ltd., Abbey Road, N.W.8.

Monday, Jan. 26th.—INFORMAL MEETING: Savoy Place, Victoria Embankment, W.C.2. Discussion on "The British Patent System and Procedure," opened by C. S. Parsons. 5.30 p.m.

Tuesday, Jan. 27th.—NORTH MIDLAND CENTRE: Corporation Electricity Department, Whitehall Road, Leeds. "Generating Plant for Military Equipment," K. H. Tuson. 6.30 p.m.—SCOTTISH CENTRE: Royal Technical College, Glasgow. "Speech Communication under Conditions of Deafness or Loud Noise," W. G. Radley. 6.30 p.m.

Friday, Jan. 30th.—MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. Discussion on "Principles of Instrument Design," opened by D. C. Gall, W. L. Beck, A. F. C. Pollard, and R. d'E. Atkinson. 5.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, Jan. 27th.—39, Elmbank Crescent, Glasgow. "The Exhaust-Pulse Pressure-Charged Two-Stroke Diesel Engine, Marine and Locomotive," H. D. Carter. 6.30 p.m.

Institution of Heating and Ventilating Engineers

Tuesday, Jan. 27th.—SCOTTISH BRANCH: The Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow. "Combustion," P. J. Hill. 7.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 23rd.—Storey's Gate, St. James's Park, S.W.1. "Gas Turbine and Marine Propulsion," T. A. Crowe. 5.30 p.m.—EAST MIDLANDS BRANCH: Nottingham and District Technical College, Shakespear Street, Nottingham. "Problems Encountered by the Royal Electrical and Mechanical Engineers in the Field," Major-General Sir E. Bertram Rowcroft. 7 p.m.—SCOTTISH BRANCH, GRADUATES SECTION: Royal Technical College, Glasgow. "Fan Design," Miss Mavis Poucher. 7.30 p.m.

Saturday, Jan. 24th.—LONDON GRADUATES' SECTION: Storey's Gate, St. James's Park, S.W.1. "The Engineer and Steelmaking," A. Roebuck. 3 p.m.—YORKSHIRE BRANCH, GRADUATES' SECTION: Technical College, Huddersfield. "Some Aspects in the Design of Plant for Steam Production and Distribution," B. Oddy. 2.30 p.m.

Tuesday, Jan. 27th.—BIRMINGHAM AUTOMOBILE DIVISION: James Watt Memorial Institute, Great Charles Street, Birmingham. Chairman's Address, G. T. Smith-Clarke. 6.30 p.m.

Wednesday, Jan. 28th.—WESTERN BRANCH, GRADUATES' SECTION: Merchant Venturers' Technical College, Unity Street, Bristol. "Organisation of a Modern Factory," J. W. Furness. 7 p.m.

Thursday, Jan. 29th.—NORTH WESTERN BRANCH: Engineers' Club, Albert Square, Manchester. Joint Meeting with Branch Automobile Division. Automobile Division Chairman's Address, G. T. Smith-Clarke. 6.45 p.m.—SOUTHERN BRANCH: University College, Southampton. "The Gas Turbine and Marine Propulsion," T. A. Crowe. 7 p.m.

Friday, Jan. 30th.—Storey's Gate, St. James's Park, S.W.1. Discussion on "Some Recent Developments in Technique of Radio Valve Manufacture," J. W. Davies, H. W. B. Gardiner and W. H. C. Gomm. 5.30 p.m.

Saturday, Jan. 31st.—NORTH EASTERN BRANCH, GRADUATES' SECTION: Visit to Messrs. I.C.I., Ltd., Billingham. 2.30 p.m.

Institution of Production Engineers

Wednesday, Jan. 28th.—Mechanics Institute, Crewe. "Mechanical Mishaps and their Relation to Design and Workmanship," G. E. Windeler. 7.15 p.m.

Institution of the Rubber Industry

Monday, Jan. 26th.—MANCHESTER AND DISTRICT SECTION: Engineers' Club, Albert Square, Manchester. "Polymer Progress," N. J. L. Megson and G. L. Hammond. 6.15 p.m.

Institution of Structural Engineers

To-day, Jan. 23rd.—MIDLAND COUNTIES BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham. "Some Practical Considerations in Design of Welded Structures," R. G. Braithwaite. 6 p.m.

Wednesday, Jan. 28th.—LONDON GRADUATES' AND STUDENTS' SECTION: 11, Upper Belgrave Street, S.W.1. "British Military Railway Bridging," S. M. Reisser. 6 p.m.

Thursday, Jan. 29th.—MIDLAND COUNTIES BRANCH: Botanical Gardens, Birmingham. Annual Dinner and Dance.—WESTERN COUNTIES BRANCH: Grand Hotel, Bristol. "Suspension Bridges in Burma," Michael Carey. 6.15 p.m.

Junior Institution of Engineers

To-day, Jan. 23rd.—39, Victoria Street, S.W.1. "Trade Marks," Geoffrey W. Tookey. 6.30 p.m.—SOUTH MIDLAND GROUP OF MEMBERS: Technical College, Park Square, Luton. "Submersible Pumps and Motors, Their Construction and Applications," W. L. Gardiner. 7.30 p.m.

Monday, Jan. 26th.—SHEFFIELD AND DISTRICT SECTION: Sheffield Metallurgical Club, West Street, Sheffield. "Seamless Steel Tubes and Pressure Vessels," T. P. Nicholls. 7.30 p.m.

Friday, Jan. 30th.—39, Victoria Street, S.W.1. "Modern Plastics," C. L. Child. 6.30 p.m.

Saturday, Jan. 31st.—NORTH WESTERN SECTION: The Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester. "Modern Foundry Practice," W. Rawlinson. 2.30 p.m.

Manchester Association of Engineers

To-day, Jan. 23rd.—Engineers' Club, Albert Square, Manchester. "Developments in Shot Blasting," R. Ankers. 6.45 p.m.

Manchester Geological and Mining Society

Tuesday, Jan. 27th.—Wigan and District Mining and Technical College, Library Street, Wigan. Ordinary Meeting. 3.15 p.m.

Manchester Statistical Society

Friday, Jan. 30th.—INDUSTRIAL GROUP: Society of Architects, 16, St. Mary's Parsonage, Manchester. "Applications of Statistical Methods in Industrial Chemistry," K. A. Brownlee. 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Jan. 23rd.—Mining Institute, Newcastle upon Tyne. "Classification Societies and the Efficiency of Hull Structures," J. L. Adam. 6.15 p.m.

Royal Society of Arts

Wednesday, Jan. 28th.—John Adam Street, Adelphi, W.C.2. "Recent Progress in the Making of Precision Instruments," A. J. Philpot. 2.30 p.m.

Women's Engineering Society

Friday, Jan. 30th.—MANCHESTER BRANCH: Visit to Salford Electrical Instruments, Peel Works, Silk Street, Salford. 6 p.m.

Saturday, Jan. 31st.—LONDON BRANCH: Visit to X-Ray Department, St. Bartholomew's Hospital, E.C.1. 2.30 p.m.

Personal and Business

MR. G. A. ST. C. EMERY has been appointed chief engineer of Philidas, Ltd.

MR. I. A. MARRIOTT has been appointed managing director of W. G. Bagnall, Ltd.

SIR JOHN B. GREAVES has been appointed a director of Ruston and Hornsby, Ltd.

MR. J. L. HENDERSON has been appointed Public Relations Officer to the British Transport Commission.

MR. CHARLES LAWRIE has been appointed an additional general sales manager of the Vacuum Oil Company, Ltd.

THE MINISTRY OF SUPPLY announces that Rear-Admiral M. S. Slattery is joining the board of Short Brothers and Harland, Ltd.

MR. S. A. LANE has been appointed a director and general manager of the Brush Electrical Engineering Company, Ltd.

MR. ROLAND HUDSON has been appointed London office manager of John Holroyd and Co., Ltd., in succession to the late Mr. Vincent Gartside.

TUBE INVESTMENTS, Ltd., announces the appointment of Mr. J. M. Surrall as a director of Simplex Electric Company, Ltd., one of its subsidiaries.

MR. H. BUTTERWORTH, A.M.I.E.E., has left the Metropolitan-Vickers Electrical Company, Ltd., to take up an appointment with Edison Swan Electric Company, Ltd.

MR. C. F. RUSSELL has been appointed chairman of the Aero Piston Ring Company, Ltd. Mr. L. H. Maidman and Mr. L. P. Gibson have joined the board of the company.

MR. J. H. B. FORSTER has been appointed chairman and Mr. B. Chetwynd Talbot, deputy chairman and managing director, of South Durham Steel and Iron Company, Ltd., and Cargo Fleet Iron Company, Ltd.

THE BRITISH TRANSPORT COMMISSION states that the headquarters of the Docks and Inland Waterways Executive has been established at 22, Dorset Square, Marylebone, London, N.W.1 (telephone, Paddington 1831).

THE BRITISH ELECTRICITY AUTHORITY announces that, from February 1st, its headquarters will be at British Electricity House, Great Portland Street, London, W.1 (telephone, Museum 6844; telegraphic address, "Beeyay, Wesdo, London").

COLLIERY ENGINEERING, Ltd., and Head, Wrightson and Co., Ltd., have entered into an agreement whereby Head, Wrightson and Co., Ltd., have been granted the rights to design, manufacture and sell coal preparation plant under the designs, patents and licences owned by Colliery Engineering, Ltd.

THE UNITED STEEL COMPANIES, Ltd., announces the following appointments at its Appleby-Frodingham branch:—Lieut.-Commander G. W. Wells, joint general manager with Mr. W. B. Baxter; Mr. A. Robinson, technical consultant and director; Engineer Rear-Admiral C. W. Lambert, general works manager; Mr. A. Jackson, Mr. G. D. Elliot and Mr. W. Geary, works managers; Mr. K. Paterson, chief mechanical engineer; and Mr. J. L. Gaskell, chief electrical engineer.

MR. H. BOYD BROWN, B.Sc. (Eng.), has been appointed sales manager of the motor department, and Mr. C. H. De Nordwall, M.I.E.E., has been appointed sales manager of the industrial control department of Metropolitan-Vickers Electrical Company, Ltd. Mr. E. A. Guthrie has been appointed manager of the American division of the Metropolitan-Vickers Electrical Export Company, at 1, Kingsway, London, W.C.2, and Mr. F. R. Mason, A.M.I.Mech.E., has been appointed principal representative of the M.-V. Export Company at Trafford Park.

THE RAILWAY EXECUTIVE, with the approval of the British Transport Commission, has made the following appointments:—Mr. R. C. Bond, chief officer (locomotive construction and maintenance); Mr. E. Pugson, chief officer (carriage and wagon construction and maintenance); Mr. C. M. Cock, chief electrical engineer; Mr. A. Dean, chief officer, engineering (works); Mr. S. E. Parkhouse and Mr. E. W. Rostern, chief officers (operating); Mr. H. Rudgard, chief officer (motive power); Mr. O. H. Corble, chief officer (marine); Mr. H. A. Short, chief officer (docks); Mr. J. Ness, chief officer (new works); Mr. E. S. Cox, executive officer (design); Mr. A. E. C. Dent, executive officer (road motor engineering); Mr. H. H. Dyer, executive officer (engineering S. and T.); and Mr. R. C. Rattray, executive officer (engineering development).

A Seven-Day Journal

British Engineers Association

ADDRESSING a gathering of the British Engineers Association at a luncheon in Manchester last week, Mr. Alfred Robens, M.P., Parliamentary Secretary to the Ministry of Fuel and Power, emphasised the importance of adequate supplies of power in industry. Mr. Robens regretted that the present economic stringency demanded some curtailment of the original programmes designed to remedy the deficiency of generating plant by 1951. The cuts would not affect the plans for 1948 and 1949, when it was hoped to install plant totalling 1150MW and 1600MW respectively. The programmes for 1950 and 1951 had, however, been reduced so that in each of these years it was now proposed to install only 1500MW instead of 2000MW of plant. Relating to matters of more specific interest, Mr. Robens mentioned the extensions involving a 60,000-kW set and two 400,000 lb per hour boilers at Stuart Street power station, Manchester. Taking advantage of the reorganisation of Bradford Pit, coal would be taken from the pit directly to the power station on an underground belt conveyor capable of handling a maximum of 200 tons per hour. The tunnel for this purpose would be 530 yards long, and the total length of the conveyor would be 717 yards, with a junction where suitable switching arrangements would allow the coal to be carried either to the stockyard or directly to the power station. Work on the tunnel is expected to begin shortly, and the conveyor is due to be in operation by mid-1950.

Disposal of Obsolete Naval Ships

ON Wednesday of last week, statements were made in the House of Lords by Viscount Hall, First Lord of the Admiralty, and in the House of Commons by Mr. Walter Edwards, Civil Lord of the Admiralty, regarding the disposal of obsolescent ships of the Royal Navy. The battleship strength of the Royal Navy had, it was stated, been under review in the light of the age and condition of the ships concerned, and their possible value in a future emergency. As a result of that review, the Admiralty had come to the conclusion that, of the capital ships remaining in the Royal Navy, the "Queen Elizabeth," the "Valiant," the "Renown," and the "Nelson" and "Rodney" were likely to be of the least value as fighting ships. The possibility of maintaining the battleships in reserve had been taken into consideraton, but they would be costly to maintain in that state, both in money and in manpower. Moreover, if they were to be of any value in a future emergency, they would need extensive refits, and modernisation, which, in view of the heavy cost and labour involved, could not be justified during the next few years. Even if that work was done, the statement went on to say, the vessels would fall considerably short of the standard and capabilities of modern construction. In particular, their speed could not be increased to such an extent as to render them capable of taking their place in a modern fleet. In view of these considerations, instructions had been issued that these vessels should be scrapped. A number of cruisers and smaller ships, all obsolescent, or of little fighting value, will also be disposed of in the near future. The Admiralty is satisfied, the statement concludes, that these reductions do not reduce the effective strength of the Navy below that required to meet any emergency which is likely to arise in the forseeable future.

Report on the South Croydon Collision on the Southern Railway

THE report of Sir Alan Mount, the Chief Inspecting Officer of the Ministry of Transport, who was assisted by Brigadier C. A. Langley, on the collision which occurred on October 24th in dense fog, at about 8.37 a.m., near South Croydon on the Central Section of the Southern Railway, has now been published by the Stationery Office. It may be recalled that the 8.4 a.m. electric passenger train from Tattenham Corner to London Bridge, running on the up main line, was improperly allowed to approach and pass through Purley Oaks, under clear signals, and came into violent collision with the rear of the 7.33 a.m. electric passenger train from Haywards Heath to London Bridge, which was passing South Croydon junction home signal at slow speed after being checked by the distant signal at caution. Both trains were crowded with passengers. It was estimated that the Haywards Heath train was carrying 800, and the Tattenham Corner train 1000, the seating accommodation being 536 and 750 respectively. Thirty-one passengers lost their lives, and the motorman of the Tattenham Corner train was killed. The majority of injuries took place in the leading coach of the second train. The primary cause of the disaster, the report states, appears to have been that Porter-Signalman H. D. Hillier, of Purley Oaks, entirely forgot the Haywards Heath train while it was in the station for six or seven minutes, obscured from his view by fog. It is difficult to account for what transpired, Sir Alan says, but responsibility must rest upon him for his most irregular use of the key to release his Sykes instrument No.18, thus destroying the protection afforded by the lock and block system to the train which was standing at starting signal No. 19. The accident would not have occurred had colour light signalling and track circuiting been installed between Battersea Park and Coulsdon, as was the railway company's intention. It was proposed to begin this work in 1940. Postponement took place, but the company's plans are now well in hand. The present signalling in use in this area has been in use over 50 years, and it is probably true to say that no other mechanical system could have coped so efficiently with such heavy main line and surburban electric services. Although Signalman Hillier acted in this instance without due sense of responsibility, his failure, the report states, seems to have resulted from insufficient experience of the Sykes signalling system. It is recommended that in addition to reviewing its methods of training and examination, the railway company should consider the propriety of placing men with short experience in charge of main line boxes.

Large Scale Generation from Wind Power

SHORTAGE of fuel has given fresh interest to the possibility of using wind power on a large scale for the generation of electricity in Great Britain. This matter was the subject of a conference convened in December last by the British Electrical and Allied Industries Research Association, and attended by various interested bodies. As a result, the E.R.A. has announced the recent establishment of a new research section on power generation. The terms of reference of this new section are to study the technical and economic problems of large scale aerodynamic generation in Great Britain; including the collection of all available information and evidence, the principles of selecting sites, the co-ordination of wind-driven generators with supply systems, the essential design features of wind-driven generators, and the design problems which remain to be solved. Mr. T. G. N. Haldane, M.A., M.I.E.E., will be chairman of the new sectional committee which is expected to consist of representatives from the electricity supply industry, electrical manufacturers, consulting engineers, the D.S.I.R., the Meteorological Office, the Ministry of Fuel and Power, and the Ministry of Supply. The research officer for the new section will be Mr. E. W. Golding, M.Sc.Tech., M.I.E.E., who is in charge of the E.R.A.'s work on rural electrification, which has already included earlier investigations on the small scale generation of electricity, principally by wind power. Wind statistics for various parts of Great Britain have, in fact, already been analysed, and estimates have been made of the energy obtainable from wind-driven generators installed in suitable districts. This work was, however, solely concerned with plant of a few kilowatts capacity suitable for supplying individual farms or small isolated communities in districts remote from normal supply systems.

Information on Electrical Engineering Laboratory Practice

A SCHEME to promote the more effective interchange of information on teaching and laboratory practice in electrical engineering is being sponsored by the Manchester Municipal College of Technology. It is proposed to issue several times a year a bulletin, in which will be given a brief account of laboratory experiment designs submitted by individual teachers. Each design will be accompanied by the name of the teacher concerned and the college with which he is associated. At the same time, the teacher concerned will be asked to submit a detailed description and constructional drawings together with any additional information which he thinks desirable, such as an account of the theory involved, a specimen laboratory instruction sheet or relevant references to other published articles. This information will be filed and made available free on loan to any teacher interested, and it is hoped to build up a library of designs for which the bulletins will form an index and summary. It is emphasised that the function of the sponsors of the scheme is merely to provide a vehicle by which such an interchange of information may be effected. The satisfactory nature and operation of designs submitted must remain, of course, the responsibility of the individual contributors. For the present, the application of the scheme is being restricted to electrical engineering laboratory work of Higher National Certificate and Degree standard, and the co-operation of colleges dealing with such work is sought. Dr. E. Bradshaw, of the Electrical Engineering Department of the Manchester College of Technology, is acting as organiser of the scheme.

Disposal of Radio-Active Effluents from Harwell

THOROUGH precautions are being taken by the Ministry of Supply to ensure that the Thames water used at the Atomic Energy Research Establishment at Harwell is returned to the river free from risk of harmful radio-activity. These precautions are being adopted after close consultation between its own experts and experts of the Ministry of Health, the Metropolitan Water Board and the Thames Conservancy, and on the advice of the Medical Research Council's Research Committee on the Medical and Biological Applications of Nuclear Physics. Roughly, one million gallons of water a day will be involved, The greater part will be used for the cooling of plant and ordinary domestic requirements at the establishment. The remainder of the water will be used for research processes, some of them radio-active, and a carefully controlled separate water system will be installed to deal with it. The most highly active portion will be segregated and will not be returned to the river. The rest of the process water will be delivered to storage tanks where it will be tested by medical officers for compliance with the agreed tolerances, treated for chemical impurities and then mixed with the domestic waste water before being discharged into the pipe which takes it back to the Thames at Sutton Courtenay. The system of treatment and examination has been designed so that several operations have to be carried out before the water actually passes into the six-mile length of discharge pipe. Moreover, a new weir is being constructed at the point of discharge into the Thames, and the Harwell water will thus be turbulently mixed with much greater quantities of river water immediately it joins the main stream.

The British Engineer in India:

HIS MONUMENT—THE FUTURE

By Sir STANLEY REED, K.B.E., LL.D., M.P.*

No. II—(*Continued from page 83, January 23rd*)

THIS brief survey†—engineers will please note that it seeks to give no more than a picture, not a detailed statement for the expert—brings us to the crowning glory of the irrigation engineer, and the triumph of the Bombay Public Works Department. Bombay was rather the Cinderella of the irrigation movement; it could show nothing to compare with the great achievements of the Punjab, the United Provinces and Madras, for although useful work was done on the Muthi and Nira rivers, the return was so small that it compared meagrely with the striking prosperity of the northern systems. Yet Bombay had its special urge in the Deccan, where it was said that the people expected one famine in every three years—and got it. A new era opened when the Irrigation Commission produced an arresting formula. It estimated the annual cost of famine; then took that figure to justify the loss on any protective works which might be constructed. With this as a basis, rapid progress was made. The Darna, Bhandardara and Bhatghar dams store and distribute waters which break the back of any failure of the south-west monsoon and bring permanent relief to the hardy but sorely tried Maratha peasantry. Incidentally, the Bhandardara masonry dam, 270ft high, was the loftiest in the world when designed, though surpassed in America before completed, and the work at Bhatghar contained more masonry than any dam then built, not excluding that at Aswan. But these did not arrest the eye; that was left in the control of the mighty Indus at Sukkur.

How slowly the mills in India used to grind! Sind, part of the Bombay Presidency from its conquest in 1842 until its separation as a separate province under the Act of 1935, starved for want of water. With a precarious rainfall of 5½in a year, vast areas of land classed as desert, but only needing water to become fertile, it always had partial use of the Indus through inundation canals flowing uncertainly when the melting of the snows in Kashmir brought down torrents in a mighty flood. These were extended year by year on a humble scale, always with the serious handicap of uncertainty; the cultivator never knew when he sowed his crop whether there would be water enough to bring it to maturity. At best, inundation permitted only a four months' crop, with its demoralising result in poor cultivation, laziness and crime. As long ago as 1855, Fife, whose work at Khadakwasla, near Poona, still stands a monument to his constructive efficiency, prepared a scheme not markedly different from that finally approved, but Fife was three-quarters of a century in advance of his time, and how furiously the heathen—the dissident engineers—raged! Every possible obstacle was raised: a barrage was unnecessary, the Indus would change its channel, as it has many times in its history, and what not; and over all these controversies one stark fact prevailed—either Sind must use the water or others would. Controversy should have ceased when Arnold Musto produced a plan so complete, so convincing in 1916 that it arrested the imagination; it was a comprehensive project to include the barrage, with four perennial canals on the left bank, and two perennial canals and one large kharif canal for rice on the right. Even then faction would not have been stilled but for two factors—the Punjab was not content to stand and gaze even if Bombay did. There was a scheme for the damming of the Indus at Kalabaghi and the dynamic energy of Lord Lloyd, then Governor of the Presidency. When work was commenced in 1923 a remarkable team was mustered under the direction of Charlton Harrison, who showed a prescient capacity for planning and direction, with Musto in charge of the barrage and its protective works and Mould of the canals. There were anxious moments, especially when an exceptional flood threatened to overtop the cofferdam, which covered an area of 49 acres, but the work went steadily forward to its opening in 1932, one of the few in history which was completed within the revised estimate. It is almost impossible to realise the magnitude of this titanic enterprise; the total length of the canals is 6816 miles, the excavation reached 6100 millions of cubic feet of soil, whilst three of the main canals are much wider than the Suez Canal, and each carries continuously about the same volume of water as the Thames at high flood. The Sukkur works have another distinctive character. Earlier construction was through manpower—not a force to be sneezed at, as the Americans recently found when they sought to close the breach on the Yellow River in China; the engineer went forth into the desert with his 80-lb tent and skeleton staff, and the labour force and the sub-contractor followed. The coolie, with his broad-bladed powrah, filled the basket between his feet, and the donkey with his panniers and the woman with her freight on her head climbed the ramps until the channel was cut and the banks raised. At Sukkur the dragline excavator and steam shovel came into operation and 55 per cent of the excavation was done by machinery. These gigantic works, which brought under cultivation an area as large as the whole irrigated area of Egypt, have been a complete success, and are now to be completed by a barrage lower down the river to feed the other inundation canals. Finally, with the great dam at Mettur, which rounds off the irrigation system in Madras, the heroic age of engineering under the British raj was passed. Not quite; all engineers know that it is one thing to bring the water on the land, and another to take it off; the Indian cultivator is prodigal in his lush waterings, and water-logging, bringing the salts in the soil to the surface and destroying its fertility, is one of the many nightmares of the public works officer. Less is known of the ingenuity of William Stampe in the Ganges Valley in sinking tube wells in the alluvium and raising the subsoil water by electric pumps drawing their energy from falls on the canal. There are some 1600 of these wells, each of 1½ cusecs yield, and they protect 1½ million acres, of which some 800,000 are annually irrigated. This is only the beginning of developments of almost limitless extent.

In the spacious days of Cotton, whose imagination was untrammelled by any petty restrictions of cost and practicability, glowing prospects were held out of canals which would bridge India from east to west and north to south, navigable as well as bringing the deserts in. These dreams passed; after long interval we come to the most striking development of irrigation—the association of electricity with hydraulic engineering. Here frankly, the British entrepreneur has lagged behind. The first step was in Mysore, and the inspiring genius Lotbiniere, one of the many products of that fine school of engineering, Kingston in Canada. The conditions were ideal; a big drop on the Cauvery and a perennial supply, with a ready-made demand at the Kolar Goldfields, 92 miles distant. Begun in 1902, that modest scheme has expanded to 42,000kW. This fired the imagination of Jamsetji Tata in Bombay, where the need was no less urgent. The coal supplies of India are for all practical purposes located in the north-east, and the great textile industry of the city was dependent for its fuel either on Britain or Natal, and later on Indian mines involving a rail haul of over 1000 miles, or the rail-cum-sea route via Calcutta, with a double break in bulk. Yet all the time there was waiting to be harnessed in the Western Ghats, with its rainfall of 300in to 600in, and a steep fall of 1800ft, sufficient power to meet all emergencies. British capital, ready enough to embark on wild-cat schemes in South America, was timid and shy; the project, even with a guaranteed off-take, was hawked round London and no takers. It was with no little trepidation that it was finally launched shortly before the war, with Indian capital, and there has been no turning back. The three separate works—the Tata Hydro-electric, the Andhra Valley and the Tata Power—all with the same character—storage of the monsoon rainfall and its conversion into electrical power at the foot of the hills, with their 215,000kW, are taxed to the full, and Bombay is one of the most completely electrified cities in the world. Not only are its mills driven by electricity but the distributing company—the Bombay Electric Supply and Tramways Company, now taken over by the municipality—bore on its books many thousands of consumers whose bills were only a few shillings a month. Madras, with the same economic conditions as Bombay—a rising industry and remoteness from the coalfields—was slower off the mark, but now has a growing electric grid, based mainly on the stations at Pykara, Mettur and Papanasan, of 30,000kW, with potential resources estimated at 220,000kW.

Owing to the extension of irrigation the Punjab passed in the lifetime of a single generation from a poor province with a congested rural population into the relatively most progressive area in India, with an energetic and adventurous population. But the Punjab is desperately short of fuel, and boldly tackled its needs with the Uhl Valley works. Like the Triple Irrigation Scheme, these were of the imaginative and adventurous character, for the headworks are in the remote Kangra Valley, and they demanded 15,000ft of tunnel through friable rock, which nearly turned the hair of the engineers grey. But if costly they were of the most beneficial character, for they distribute 48,000kW of electrical power over an area destitute of other fuel than wood through a transmission system said to cover an area as large as the grid of Britain.

What of the results and what of the future? Britain, through its engineers, has bequeathed to India 80,000 miles of canals, fertilising 70,000,000 acres of land previously largely desert, and to-day 31 per cent of the Punjab, 18 per cent of the United Provinces, and 19 per cent of Sind are irrigated, and this in a country which before was entirely

* Sometime Editor of *The Times of India*

† A review, "Indian Irrigation and Power Projects," appears on page 112.

dependent on the monsoon rains, which induced appalling destitution, loss and suffering when they failed, bringing not only starvation, but disease in their train. The future? First look at the inescapable problems which have to be faced.

The new responsible governments—India and Pakistan—have to grapple with the most tremendous situation which has ever confronted any administrations. Slowly there is emerging from the din of politics the stark realities. The population of India is 410,000,000, increasing at the rate of 5,000,000 a year. If space permitted, it would be a fascinating task to trace the forces which have induced a population increase which was manageable until 1911, or perhaps 1921, to these appalling proportions. How is this population to be kept alive, much raised from a deplorably low living standard, especially when the exports of Burma rice, which used to furnish a balancing reservoir of 2,000,000 tons, will not be fully available for years, if ever. Food, and yet more food, is the insistent cry, because population growth is like a glacier—its progress cannot be arrested, except possibly over generations. Never was the air so full of gigantic projects, which seem to take no account of crores of rupees, or a demand on the engineering resources of the world. We may be assured that all major works in future will be carried out through Government agency, and departmentally rather than through contractors, and that every irrigation project will be linked with the generation of hydro-electric energy, distributed through expanding grids. The administrative machinery to these ends has already been set up. Moreover, all these projects presuppose the establishment of strong governments and a supply of capital far transcending anything raised in the past.

Surveying this ambitious programme, the schemes most likely to come to early fruition are the Bhakra dam and the Damodher Valley project. The Bhakra dam is an old friend of thirty years and is hedged in by the allocation of the waters between the Provinces and States affected. It comprises a dam 480ft high across a gorge in the river Sutlej, with 220 miles of lined canals, commanding 4,500,000 acres and a potential of 160,000kW of electric power, at a cost of Rs.42 crores.

The Damodher scheme is based on the lines of the T.V.A. and is of the most comprehensive character. It is designed to take control of the Damodher, which rises in Chota Nagpur and falls into the Hughli, 30 miles below Calcutta; it aims at the complete control of the floods, the provision of 300,000kW of electric power and the command of 760,000 acres, with facilities for navigation, at a cost of Rs.55 crores. Owing to their special experience of high dams and of the T.V.A., American engineers have been called in and it is announced that they are opening permanent offices in India. At the moment every Provincial Government—and these provincial governments are as large as States—is bursting with constructive energy and given stable administration, a sufficient supply of capital, and the necessary machinery, the activities of the future will make even the great achievements of the past seem almost insignificant.

Inevitably, in a desperately thirsty land, the irrigation engineer has dominated the scene, but the railway constructor is entitled to his pæan. Every time I have passed up and down the Western Ghats, now electrified, I have never failed to admire the bold men who carried the lines over the Thul and Bhore passes, generally following the course of the old military roads, and with gradients almost inconceivable in those days. A passing tribute to their foresight. When, owing to the growth of traffic, it was necessary to replace the old reversing stations by direct transit, the final plans were almost identical with those of the first surveyors. Few, save those on duty bent, know of the Hurnai route to Quetta, and how the engineers wrestled with the intractable Mud Gorge, and then turned to the steep Bolan, with the Khojak Tunnel, which the Amir of Afghanistan said was a knife thrust into his vitals. I could a tale unfold of the last span in the Hardinge Bridge, just dropped into place before the floods came down, but that is familiar to all who know their India; I should like to write of the successful training works which laid the bogey of changes in the courses of the great rivers, without which dams and bridges might have been left high and dry; but that is another story.

Ships pass in the night. Cotton, Cautley, Wilson, Jacob, Harrison, Hill and Beale, these are hardly names to-day. In how few years will they be forgotten. Their works will stand for evermore. Behind them have stood those great firms of consulting engineers, constantly refreshed by partners with recent Indian experience, who fortified the designers with their world experience. Surveying the scene, what time Britain has remitted her control of the sub-continent to Indian hands, we are proud to think how few mistakes were made, how permanent their handiwork; the engineers have stamped on Indian soil those qualities which we like to think are inherent in the British way of life—disciplined imagination, solidity of construction, and a tenacity which refused to be discouraged by any obstacle; their monument is that of the great Wren.

The Gas Turbine as Applied to Marine Propulsion*

By T. A. CROWE, M.Sc., M.I.Mech.E.†

No. I

Introduction

Historical Survey.—The gas turbine is "new" only so far as its application to marine propulsion is concerned, because its development has been proceeding over a long period of years. The first patent for a gas turbine was granted in 1791 to John Barber, whose proposals were surprisingly close to modern principles, and included the injection of water into the combustion chamber, both to cool the products of combustion and augment their volume. The drawing accompanying this patent is shown in Fig. 1.

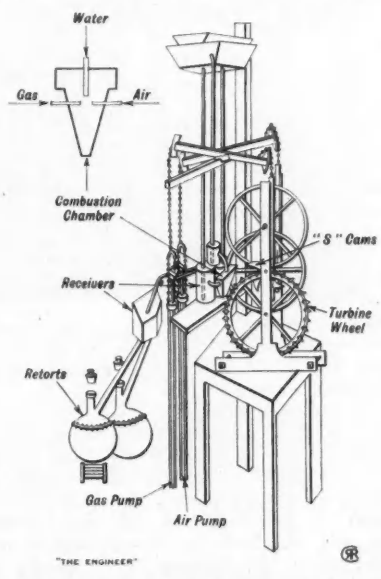


FIG. 1—JOHN BARBER'S GAS TURBINE PATENT, 1791

Coal or wood-gas from the retorts, and a supply of air, were pumped into receivers where the pressure was kept steady by the head of water in the tank above. The gas and air then flowed into the combustion chamber, where a jet of water was added, and the resulting combustion gases impinged on the vanes of the turbine wheel, thus providing the power to drive the pumps through the S-shaped cams, and also, it was hoped, power for operating hammers, winches, grinding and spinning machinery, and "for any kind of motion whatsoever."

In spite of early theoretical work, little success was obtained in the practical development of the gas turbine. There were two principal causes for the delay in its development: first, the difficulty of obtaining materials which would stand up to the high temperatures necessary, and secondly, the low efficiencies of both compressors and turbines. As a result, the compressors absorbed more power than was developed by the turbine, and therefore power would have had to be supplied to the unit to enable it to run at all. In Fig. 2, the various curves give an indication of the improvement in turbine and compressor efficiencies, and the development of heat-resisting metals, during the last few decades, and Fig. 2*d* shows the overall thermal efficiency, based on these temperatures and efficiencies, of a constant-pressure gas turbine. The latter curve shows that it was only about 1918 that development had advanced to a stage when a practical gas turbine would give just sufficient power to drive its own compressors. Once this stage had been reached the improvement in efficiency was rapid. This curve is given here primarily to emphasise this rapid improvement, but it must not be assumed that the history of the gas turbine can be accurately described by a single curve. Some success was obtained before 1918, by adopting various expedients in order to overcome the effects of low machine efficiencies and inadequate strengths of materials. Little was known in the early days about creep of steel at high temperatures, and often gas turbines were run at temperatures which would have resulted in early failure. Sometimes systems were adopted for cooling the blades, or water was injected into the combustion chamber. The 1000-hour life, on which the curves in Fig. 2*d* are based, is not considered sufficient for a marine plant, so it must not be assumed that the present-day efficiencies shown in this figure can be obtained in marine installations.

Nevertheless, by the beginning of the

* Institution of Mechanical Engineers. January 23rd. Twentieth Thomas Lowe Gray Lecture. Abstract.

† Engineering Director, John Brown and Co., Ltd., Clydebank.

twentieth century, turbine and compressor efficiencies were approaching the stage which allowed of the development of the gas turbine which would at any rate drive itself, even if it did not supply much external power!

The first large-scale gas turbine to develop sufficient power to drive its own compressor and still have a margin to do useful work, was that built by the Société des Turbomoteurs of Paris about 1905, and is shown in Fig. 5. This turbine operated on the constant-pressure cycle, and was designed by Armengaud and Lemale. It consisted of a Curtis wheel 37·4in in diameter, driving a 400 h.p. centrifugal compressor designed by Rateau, with twenty-five stages in three cylinders, and ran at 4250 r.p.m. Most of the compressed air was used as combustion and cooling air in the turbine; the remainder was tapped off for use elsewhere, and represented the useful output of the plant. The fuel consumption was approximately 4¾ lb of oil per effective horse-power per hour, which corresponds to a thermal efficiency of about 3 per cent.

The Constant-Volume Gas Turbine.—The inefficiency of the early compressors, which resulted in such a large proportion of the output of the turbine being required to drive them, caused the designers of this period to investigate cycles which avoided the use of air compressors. The only cycle to become a practical proposition, was the constant-volume cycle developed by Holzwarth, who began experimenting in 1906. In his original turbine, air was taken into the combustion chamber at atmospheric pressure, after which gas was admitted and fired electrically at constant volume, thus raising the pressure to between 70 lb and 100 lb per square inch. After ignition had taken place, a valve opened and allowed the gas to pass through the nozzles to the turbine wheel which consisted of two velocity stages. The combustion chamber, nozzles, and turbine were all water cooled, and the steam generated in the water jackets was used in a separate turbine which drove the scavenging blower.

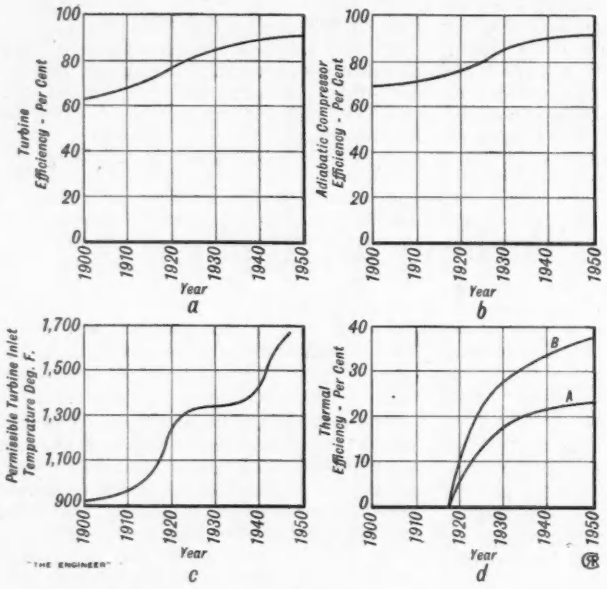
The first Holzwarth gas turbine was built in 1908 by Körting, at Hanover, and was designed for 50 h.p. The second machine was built by Brown Boveri in 1909–10, and is shown in Fig. 6. It had a vertical shaft and was designed to give an output of 1000 h.p. This power was never obtained, but nevertheless it may be considered to be the first economically practicable gas turbine.

A great deal of further development was done on the Holzwarth gas turbine, and in later plants the explosive mixture was precompressed to about 40 lb per square inch, whereby the final explosion pressure was raised to about 200 lb per square inch. Two discharge valves were fitted to the explosion chamber, the second one opening after the first, when the pressure had fallen considerably, and admitting the lower pressure gases to the turbine through a passage which by-passed the first turbine wheel. A 2000 h.p. unit uses blast-furnace gas, and was built by Brown Boveri, and installed in the Thyssen Steel Works in Hamborn in 1933. A 5000 h.p. unit was installed in Germany during the war, but no details of this are available. Although the constant-volume type of gas turbine developed by Holzwarth is attractive in that it dispenses with the need for an air compressor, the complication of the valve gear required, and the cooling system and associated steam plant, more than outweigh this advantage; to-day, the simpler form of constant-pressure gas turbine is generally preferred.

Improvements in the Simple Constant-Pressure Turbine.—The efficiency of a gas turbine working on the simple cycle can be increased by various means. The greatest individual improvement that can be made is the fitting of a heat exchanger, by which the heat in the exhaust gases can be transferred to the air, between the compressor and the combustion chamber. The efficiency can be further improved by compounding the compressor, and intercooling between the stages; and also by compounding the turbine, and reheating between the stages.

In a plant with a heat exchanger and two stages of heating, the optimum overall pressure ratio is about 10, compared with the ratio of about 3½ for a cycle with a heat exchanger, but with only one stage of heating. This larger overall pressure ratio results in a greater specific output (or shaft horse-power per pound of circuit air per second) so that the plant becomes smaller for a given power output.

The saving of fuel due to the preheating of the air in the heat exchanger is not obtained without certain disadvantages, the chief of which are an increased frictional pressure drop through the circuit and, of course, the increased weight, size, and first cost of the plant. The size and weight of a heat exchanger may be reduced by designing for high air and gas velocities which would give better heat transfer rates, but high velocities involve serious pressure drops. Again, with a given surface area of a tubular heat exchanger the weight and size may be reduced by using a greater number of smaller diameter tubes. In the open cycle, however,



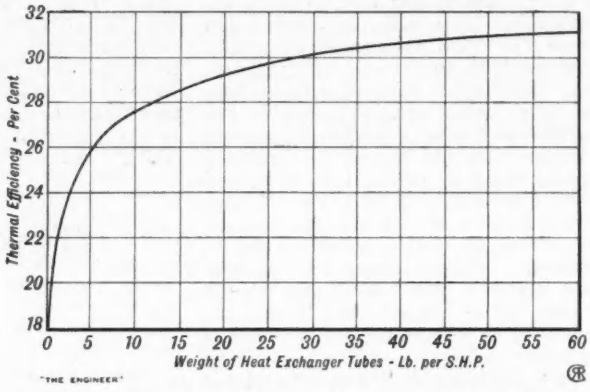
a.—Turbine efficiency.

b.—Adiabatic efficiency of rotary compressors.

c.—Permissible turbine inlet temperatures for a life of 1000 hours, based on the temperature at which a stress of 3 tons per square inch results in a creep rate of 10^{-6} inch per inch, per hour.

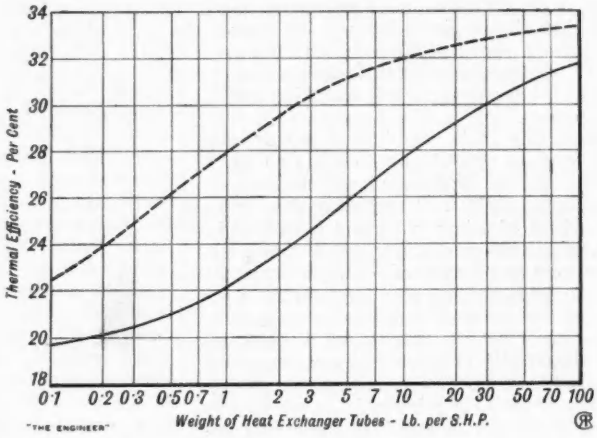
d.—Overall thermal efficiency of a simple constant-pressure gas turbine (A) without heat exchanger and (B) with heat exchanger of 70 per cent effectiveness.

FIG. 2—TURBINE DEVELOPMENT, 1900 TO 1950



Turbine inlet temperature 1200 deg. Fah.; compressor inlet temperature 60 deg. Fah.; turbine efficiency 90 per cent; compressor efficiency 85 per cent; expansion pressure ratio 4·0; heat exchanger tubes ¾in outside diameter, and tube wall thickness 18 S.W.G.

FIG. 3—INCREASE OF THERMAL EFFICIENCY WITH INCREASING WEIGHT OF HEAT EXCHANGER TUBE NEST



——— Curve of Fig. 3 on logarithmic scale; ¾in tubes, and open-cycle pressures.
— — — ¾in tubes and closed-cycle pressures.

FIG. 4—EFFECT OF USING SMALLER-BORE TUBES AND INCREASED PRESSURES

the combustion gases pass through the heat exchanger tubes, and so their diameter cannot be reduced below a size determined by considerations of fouling and cleaning. In any particular installation a compromise must be made between these factors depending on the relative importance of low fuel consumption, low first cost, lightness, compactness, and ease of maintenance.

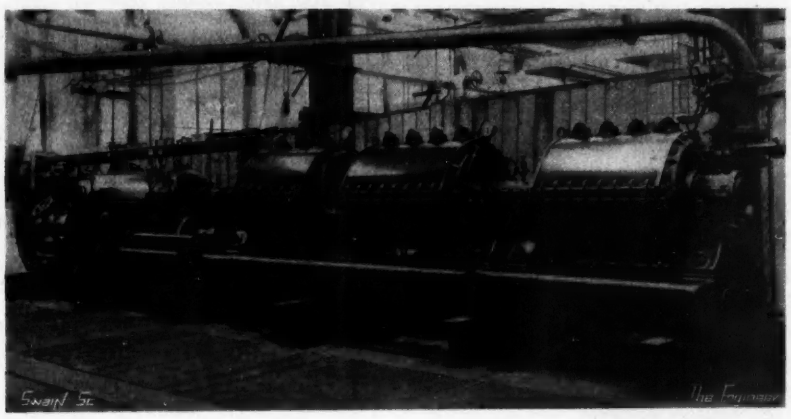


FIG. 5—ARMENGAUD AND LEMALE'S CONSTANT-PRESSURE GAS TURBINE, 1905

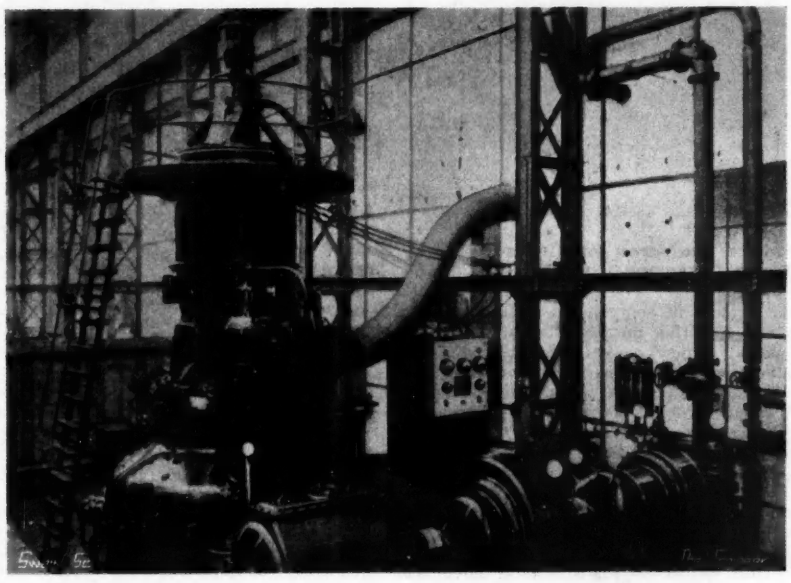


FIG. 6—HOLZWARTH'S GAS TURBINE BUILT BY BROWN BOVERI, 1909–10

The curve in Fig. 3 shows how the efficiency of a simple open-cycle plant increases with the increase in weight of the heat exchanger. The weights given in this figure are for the tubes only, which have been taken as of $\frac{3}{4}$in outside diameter and 18 S.W.G. wall thickness, the weight of the shell of the heat exchanger having been omitted. It has been assumed that the arrangement of the tubes in the heat exchanger has been so proportioned that the pressure drop is the same for all sizes. In order to cover a wider range this curve has been redrawn in Fig. 4 on a logarithmic scale, and a second curve added above to show the efficiency obtained when using smaller tubes and high pressures on either side of the heat exchanger. The upper curve is based on $\frac{1}{4}$in diameter tubes, and a pressure of seven atmospheres on the low-pressure side of the heat exchanger, conditions typical of a closed-cycle plant, as will be described later. This improvement in efficiency due to small tubes and high pressures is not fully obtained in the closed cycle, for there is a loss associated with the air heater of the closed cycle which partly counteracts this gain. The upper curve in Fig. 4 is intended only to emphasise the advantages of smaller tubes and higher pressures in the heat exchanger.

(To be continued)

The North of Scotland Hydro-Electric Board's Training College

THE North of Scotland Hydro-Electric Board announces the establishment of a residential Staff College at Pitlochry for the training of technical staff in the varied aspects of its schemes for the generation, transmission and distribution of electricity and such other activities in which it may be competent for the Board to engage. Professor S. Parker Smith, D.Sc., M.I.E.E., A.M.I.C.E., is relinquishing the Chair of Electrical Engineering at the Royal Technical College, Glasgow, to arrange and superintend the training scheme, and Mr. J. A. Cowan, A.R.T.C., M.I.E.E., lately Senior Lecturer on Electrical Engineering at the Royal Technical College, Glasgow, has been appointed Master of the College. The College will be situated on the Pitlochry estates of Faskally and Port-na-Craig (formerly Fonab Castle), recently acquired by the Board, which adjoin the new loch to be formed by the Pitlochry dam, and which will have Clunie power station at one end and Pitlochry power station at the other. There will be ample residential and workshop facilities at the two mansion houses and outbuildings. It is also possible that Pitlochry, in view of the facilities available, will prove a most suitable site for research work. In addition to providing the required hostel facilities, the area selected for the College will become one of the Board's main centres of activity, as many of the larger hydro-electric generating stations are within easy reach. It is intended that on appointment the technical staff will spend a short training period in the College before being allocated to specific duties, returning for further instruction and refresher courses as and when circumstances may require. The syllabuses will be kept flexible to meet requirements, and will include operational duty at hydro-electric, diesel and steam stations, and maintenance of transmission systems as well as visits to projects under construction and factories where new plant is being built. Lectures on the Board's schemes, on the economic and communal life of the Highlands and on future planning will be given, so that the staff recruits will start their duties with a wide knowledge of the Board's programme and its effect on the development of the Highlands, and with a better appreciation of the position of the technician in relation to other interests in the Highland area. In isolated areas it is essential that each member of the staff shall be mobile, so that driving instruction and vehicle maintenance will be a part of the practical work. The Staff College will also form a valuable reserve pool of technical assistants for emergencies. With the generation of electricity from the first new projects now in sight, plans for the opening of the College are well advanced. Staff recruiting will begin this year.

Road Maintenance

THE president of the Institution of Municipal Engineers, Mr. J. B. L. Thompson, M.I.C.E., has drawn attention this week to the Government's proposals for manpower allocation, which include the reduction by 20,000 of the men at present available for road maintenance. He says that technical officers of local authorities responsible for the care and upkeep of highways in Great Britain are gravely concerned lest the reduction be made without full knowledge of the consequences. The latter have been considered by the council of the Institution of Municipal Engineers. Whilst the Institution has no desire or intention to enter into this matter from the point of view of national policy, it feels it to be a duty and responsibility in the public interest to make known the effects of the withdrawal of men from the roads for an indefinite period of time. Mr. Thompson points out that during the years of war, local authorities had of necessity to discontinue their routine and postpone the programme of road maintenance except in special circumstances, and the fact that as a whole the roads remained reasonably serviceable in spite of enforced neglect is evidence of the original soundness of construction and the high standard of upkeep in the past. It is obvious, however, Mr. Thompson observes, that many roads call for extensive repairs, and the work to be done must be done with speed if the rate of deterioration is to be restrained. The Institution of Municipal Engineers feels that further neglect of roads at the present time may result in a rapid decline to a degree which will not only affect the ease, convenience and safety of transport, but will also prove unwise and costly in the end, and Mr. Thompson urges that the consequences of the withdrawal of labour from the maintenance and servicing of roads should be considered very carefully and earnestly.

The Gauge and Tool Exhibition

No. I

THE second Gauge and Tool Exhibition was officially opened by Mr. Oliver Lyttelton at the New Hall, Vincent Square, London, S.W.1, on Monday last, January 26th, and will be open daily, from 10 a.m. till 7 p.m., until Friday, February 6, 1948. At the invitation of the organising body, the Gauge and Toolmakers' Association, the National Federation of Engineers' Tool Manufacturers is participating in this year's exhibition.

As in 1946, the exhibition contains a representative selection of the latest designs of gauges, tools, jigs, fixtures and other special precision equipment. The exhibits are many and varied, and it is interesting to note from them that this country is now virtually self-sufficient for practically all types of precision measuring equipment, and that the foundations have been laid for a substantial export trade. Adequate and efficient tooling and means of inspection are an essential feature in economic production, and the wide range of equipment now being made in this country is an important factor in its great production drive.

In addition to an extensive range of standard types of small tools a prominent feature of the exhibition is the large number of both standard and special diamond and carbide tools, taps and dies, and hobs and cutters of all types which are now being made by several firms for general production and high precision work. Amongst the many precision instruments of recent design, optical instruments occupy an important place in the exhibition. It is only possible at such an exhibition to appreciate the rapid growth which has taken place in a relatively few years in this country's high-precision optical instrument industry. Like many of the other exhibits the design and construction of the optical instruments show that they are equal, if not superior, to those which were hitherto considered only obtainable from abroad.

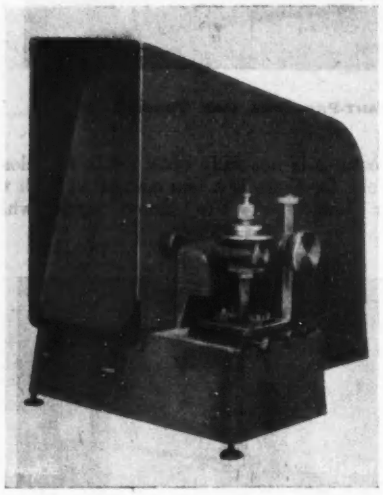
British toolmaking has always been to a very high standard and the many examples of jigs, fixtures, moulds, press tools, &c., to be seen upon the stands show that the production side of British industry will never fail for the want of well-designed tools built by craftsmen of a high order.

In dealing with this exhibition it is not easy to select individual items for detailed description from amongst such a wide range of special purpose equipment as is being shown. On every stand there are to be seen excellent and interesting examples of the tool, instrument and gauge maker's art. We have, therefore, tried to choose a few of the tools and some measuring equipment of wider application for purposes of description, and to give some indication of the range of the exhibits. It must, however, be stressed that they are by no means indicative of the full scope of the exhibition, to pay full justice to which would occupy far more space than is at our disposal in these days of paper restrictions.

Optical Measuring Tools, Ltd.

Two recent additions to the range of high-precision optical measuring instruments made by Optical Measuring Tools, Ltd., of Slough, Bucks, are a new profile projector and a projection type rotary table.

The profile projector has been specially developed for the inspection of three-dimensional profiles in components such as turbine blades. For this purpose the company has developed a new optical system whereby a small screen of about 6in diameter is used with a large magnification. For the standard instrument, which is shown in the accompanying illustration, a magnification of thirty times has been adopted, and it can be used for inspecting the contours of turbine blades up to 3½in wide, 1in thick and 8in long. By the provision of a special column longer blades can be accommodated.



Profile Projector for Inspection of Three-Dimensional Contours—O.M.T.

The work is held vertically in a holder which is quickly adjustable for rotational movement and height adjustment to the points at which it is desired to inspect the blade. Both movements are made by quick-acting ratchet locators which may be easily interchanged for different types of blades. These features are intended for production gauging, but provision is also made for laboratory use by incorporating a rotational scale together with slip gauge height location. Two diametrically opposed stylii are mounted on a freely floating table and are lightly spring loaded with automatic reversion of direction against the blade sides. The action of following the blade contour is by rotation of a single knob which traverses one stylus along one side of the blade; when the end of the blade is reached the other stylus is automatically brought into action and as the knob is turned back again, it traverses the opposite side of the blade. The floating table which is integral with the stylii also carries a graticule consisting of two arcular spots containing the appropriate work tolerance and spaced at an identical distance apart to the two stylii. By this arrangement as the stylus follows the blade contour the graticule follows an identical path.

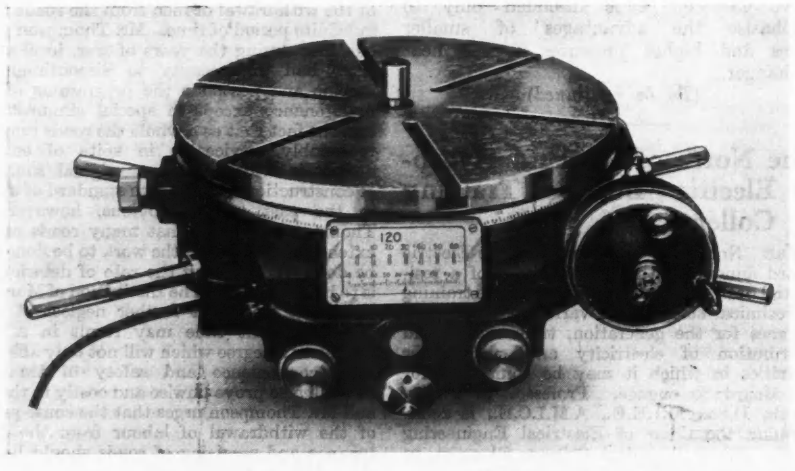
The image of the graticule is made to focus optically on to another graticule on which are marked profile sections of the particular blade being examined. The two graticules are then projected on to the screen, but the optical elements are so arranged that the spot image remains stationary, and the image of the graticule containing the profile section of the blade is made to follow the movement of the stylus. This design results in a stationary tolerance spot through which travels the enlarged image of the blade profile. Only one of the spots is seen on the screen at a time, but as the second stylus comes into operation so the other spot with its accompanying profile comes into view.

When using the projector the operator merely turns the knob traversing the floating table to and fro and observes the profile of each side of the blade passing through its respective tolerance spot, and any deviation outside the tolerance zone indicates that the section of the blade at that particular point is either thicker or thinner than the allowed section, as the case may be. The blade is then raised or lowered with the holder to the next ratcheted stop, and the same operation performed at the new position.

A number of improvements have been incorporated in the new 16in rotary table being made by the firm. It has a projection screen whereby the scale can be read accurately and quickly; it is fitted with particularly sturdy bearings, and incorporates a worm and wheel hand drive with two speeds.

The projection screen, which can be clearly seen in the photograph we reproduce, is 3¾in long by 2in high. A circular glass scale accurately divided into degrees is projected on the screen, together with two graticule images. Two knobs, each of which can be locked independently, at the front of the table control the optical micrometer. One knob controls the zero setting of the minute scale, and the other is used for setting the indicator line to the final position. The minute scale can be reset to the nearest ten minutes and this feature can be usefully employed when it is impractical to start at the absolute zero.

It is claimed that with this table readings can be made and repeated to an accuracy of two seconds, and that the circular accuracy is in the region of six seconds.



Rotating Table with Projection Screen—O.M.T.

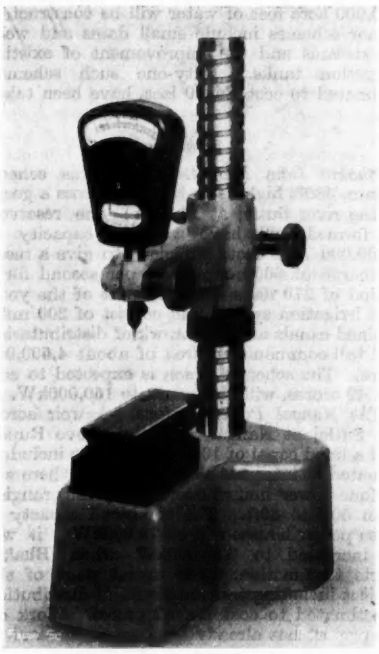
Sigma Instrument Company, Ltd., and Offen and Co., Ltd.

A particularly comprehensive display of high-precision measuring and inspecting equipment is to be seen upon the combined stand of the Sigma Instrument Company, Ltd., of Letchworth, Herts, and Offen and Co., Ltd., of South Nutfield, Surrey, which has been arranged by E. H. Jones (Machine Tools), Ltd., the sole distributors of these companies' products. Although all of the equipment exhibited is interesting a majority of it is now familiar and we have, therefore, selected one or two of the more recently introduced instruments for purposes of description.

The well-known range of "Sigma" comparators has been extended by the introduction of two new models, the "Junior" and the

"Minor." The "Junior," which we illustrate, has a double-scale and is designed for spigot or back plate mounting. The main scale of the instrument covers a range of 0·001in at 1000 times magnification, or 0·002in at 500 times magnification. Below the main scale is a secondary scale covering a range about six times as great as that covered by the main scale. This second scale on the instrument is used for inspecting parts during manufacture, as it is designed to indicate the amount of material which must still be removed before the part is the correct size. As the part nears the predetermined size the pointer operating over the main scale is energised and critical measurement can be taken on the finished product.

The Sigma "Minor" comparator has been developed as an instrument with a high magnification covering a relatively short range for the inspection of parts where the tolerance is only a few ten thousandths of an inch. This comparator has a magnification of up to 4000 times and an accuracy of a few millionths of an inch. When arranged for a magnification



"JUNIOR" COMPARATOR—SIGMA

of 4000 times the instrument covers a range of 0·0005in and, with a magnification of 2000 times, 0·0001in.

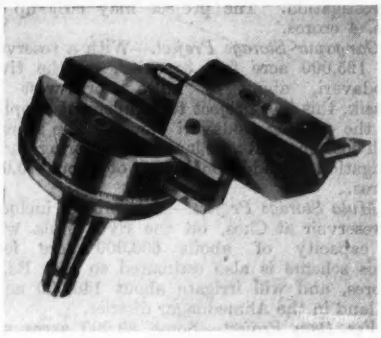
Both the "Junior" and the "Minor" comparators can be fitted to a well-designed and convenient stand, and built up to a complete comparator, the standard model of which has a capacity of 6in.

LUSHINGTON TOOL MANUFACTURING COMPANY, LTD.

The comprehensive range of precision tools and instruments displayed by the Lushington Tool Manufacturing Company, Ltd., of Hailsham, Sussex, includes many sizes of boring heads ranging up to 20in diameter capacity.

Amongst these boring heads is the firm's recently introduced "Interslide" boring head, which we illustrate. In this tool a large way cut across the full width of the body carries a substantial tool holder slide, the travel of which is limited by stops to 1½in. This slide is locked in any required position by means of a small Allen screw, and the restricted length of travel ensures that a major portion of the slide is always contained and rigidly supported in the body. A tee slot in the slide allows the tool holder to be quickly and easily adjusted along its length by the operation of a single heavy clamping screw. The length of tool holder travel in the slide makes possible the limitation of the slide movement to 1½in, and at the same time considerably increases the capacity of the head.

The tool holder has holes bored in it for three tool positions—one at 90 deg. to the axis of the head, one at 45 deg. to the axis, and one on the axis line. The two first-mentioned tool



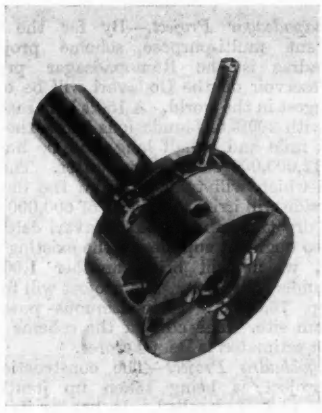
BORING HEAD—LUSHINGTON

holes accommodate ½in diameter bits, and that on the axis line has a diameter of ¾in. This large tool bit hole permits the use of a heavy boring bar for deep boring purposes. The tools are fixed in position in the holder by means of wedge type cotters. The design of the tool slide is such that special tool holders intended to suit special applications can be fixed in the tee slots.

The main tool slide is moved radially in the head by means of a scroll ring, which is slightly larger than the body and knurled to provide a hand grip. This ring is graduated to read to 0·0005in.

The makers state that the head can be used to bore holes up to 14in diameter with 1½in of tool overhang in the 45 deg. position, or with similar overhang in the 90 deg. position.

We also illustrate the largest of three useful knurling tools of the release type now being made by the company. This tool has three knurling wheels and is claimed to be particularly suitable for working on thin section tubing or light components. In it the knurling wheels are set by means of a simple screw attachment, and after initial



KNURLING TOOL—LUSHINGTON

setting the wheels are moved into their operative or clear position by the movement of a single small lever. The tool is so designed that knurling can be effected on components having an obstruction at the end, such as with double-ended plug gauges. It can be set to knurl a small central portion of a component, and, no matter what operative setting is employed, the knurls open out to their full extent for the tool to be withdrawn over a larger diameter. This type of knurling tool has straight serrated wheels, the carriers of which can be moved on their axes to produce diamond knurls.

S. L. VAN MOPPES, LTD.

The range of diamond tools on the stand of S. L. Van Moppes, Ltd., 32/34, Holborn Viaduct, London, E.C.1, includes a useful design of self-positioning swivel head tool. This tool is used with a diamond, having either five or seven cutting facets, the bit of which is mounted in a swivelling head on the body of the tool holder. When a nut which holds the head rigidly on the central pivot is released the head is raised slightly by a spring, and can be turned through an angle of about 15 deg. by hand to present the next facet of the diamond to the work. To ensure the correct angle through which the head is turned a series of small holes is drilled in its base. These holes are engaged in turn, as the head is rotated, by a stop projecting upwards from the tool holder. The design of the tool is such that each facet of the diamond can be brought in exact relation to the work without having to be optically viewed by the machine operator after the first positioning.

PRECISION GRINDING, LTD.

Together with a selection of the various types of gauges, form cutting tools and other tools to be seen upon the stand occupied by Precision Grinding, Ltd., Mill Green Road, Mitcham Junction, Surrey, there are a number of optical measuring instruments made by that company.

Amongst these instruments is a useful little cutter microscope which has been developed

CUTTER MICROSCOPE—PRECISION GRINDING

for use in the die sinking and engraving trades, to enable the accurate checking of radii and angles on cutting tools. This instrument, which we illustrate, consists of a fifteen-times magnifying microscope tube which accommodates an interchangeable graticule in the eyepiece. The standard graticule supplied with the instrument is engraved with angles and radii, but where it is required to use the microscope with special form tools appropriately engraved graticules can quickly and easily be inserted.

A substantial base, from which extends an inclined pillar, carries a simple vee-shaped work rest designed to accommodate a wide range of cutters and tools of various sizes. The microscope tube is carried on a slide on the inclined pillar along which it can be adjusted through a fine screw for focusing purposes.

Visitors to this stand will note that a certain number of improvements have been made in the horizontal comparator made by this company for checking both plain and screwed plug and ring gauges. The measuring arms are now interchangeable and are carried on triangular columns giving the instrument a very high degree of accuracy and facilitating the change over of settings.

(To be continued)

Indian Irrigation and Power Projects

FOLLOWING upon the article by Sir Stanley Reed begun in our last issue and continued in this under the title "The British Engineer in India," we print below some particulars condensed from the publications of the Central Board of Irrigation and power projects in India.

The Indian Government's drive towards industrialisation has brought the problem of utilisation of water power to the forefront. India's immense wealth of rivers and streams has hitherto been exploited spasmodically and without concerted plan. The British Government has undoubtedly a proud record of irrigation works in India, but most of them were carried out during the last century when the science of hydraulics and irrigation engineering was in its infancy. Consequently there have been instances where the benefits have been seriously impaired by losses in directions which had not been foreseen, e.g., waterlogging in canal colonies of the Punjab and the occasional drying up of the Uhl river operating the Mandi hydro-electric stream. The Government has now a comprehensive plan of co-ordinating research in water utilisation by setting up a Central Waterways, Irrigation and Navigation Research Station at Delhi. This station will keep contacts with the other research stations in the country and work in conjunction with the Indian Waterways Experiment Station at Khadakvaola, Poona.

Bengal

Damodar Valley Project.—This project is Bengal's most important scheme under investigation. It will provide perennial irrigation to 750,000 acres and generate 3,000,000kW of power. The project is expected to cost Rs. 55 crores and is anticipated to give the cultivators an additional income of Rs. 6 crores every year.

Mor Project.—Work has already started on this project on the river Moorakshy in Birbhum District. The scheme is to cost Rs. 7 crores. The area the new canals will irrigate will be in the vicinity of 600,000 acres yielding an annual crop worth Rs. 4½ crores. In addition there will be a small hydro-electric generating station.

Tista Project.—This project comprises a dam across the Tista, just upstream of the Coronation Bridge. It will be about 700 ft high, and will impound 3,500,000 acre feet of water. The power plant may have an installed capacity of over 500,000kW. It is expected that a steady average supply of 15,000 cusecs will be available throughout the year for the canal. This discharge is equivalent to that of the river Thames in high flood at London.

Bihar

Kosi Valley Project.—This is the most experimental of all projects in India. It is being prepared by the Central Waterways, Irrigation and Navigation Commission as a multipurpose project for flood control, silt control, soil conservation, irrigation, drainage, reclamation of waterlogged areas, malaria control, navigation, power, fish culture and recreation facilities. The most important feature of the scheme will be a dam over 700ft high to store about 10,000,000 acre feet of water and generate about 1,000,000kW of continous power. To give an idea of the quantity of power to be generated, it is interesting to record that it will be twice the total hydro-electric power now installed throughout India. Considerable areas will be brought under irrigation, and Bihar would be spared the immense destruction of valuable land caused by vagaries of the uncontrolled river Kosi.

Bombay

Girna Storage Project.—This scheme consists of a storage tank at Panjham on the river Girna, a tributary of the Tapti. It will have a capacity of nearly 500,000 acre feet. Possibilities of power development are under investigation. The project may cost up to Rs. 4 crores.

Gangapur Storage Project.—With a reservoir of 125,000 acre feet capacity, on the river Godavari, about 8 miles north-west of Nasik, this is a project to supplement supplies to the evisting Godavari Canals. The scheme will cost about Rs. 80 lacs and will bring under irrigation an additional area of about 40,000 acres.

Mula Storage Project.—This project includes a reservoir at Chos, on the river Mula with a capacity of about 500,000 acre feet. This scheme is also estimated to cost Rs. 4 crores, and will irrigate about 140,000 acres of land in the Ahmednagar district.

Vir Dam Project.—Some 80,000 acres will be irrigated at an expected cost of nearly Rs. 2 crores. The scheme includes a dam 105ft high at Vir across the Nira river in the Poona district. The reservoir will have a capacity of 200,000 acre feet, and will supplement the scanty supply now run in the Nira Right Bank Canal.

Mahi Canal Project.—This project comprises a reservoir on the Mahi river with a capacity of 160,000 acre feet, a pick up weir half a mile long and 60ft high at Wanora, and a canal 68 miles long which will command 3,000,000 acres in the Khera district.

Tapti Canal Project.—A masonry pick up weir, 26 miles above Surat, and a canal to irrigate an area of 230,000 acres are included in this scheme.

Central Provinces

The Government of Central Provinces decided in 1929, on the recommendation of a committee, that no new state irrigation works should be undertaken. Conditions have, however, changed and recently Government sanctioned the construction of three irrigation tanks in the Balaghat and Chindwara districts, designed to irrigate 20,000 acres of rice in 57 villages and the additional yield on account of these new tanks is estimated at 3800 tons per year.

Madras

Ramapadsagar Project.—By far the most important multi-purpose scheme projected in Madras is the Ramapadsagar project. This reservoir on the Godavari will be one of the biggest in the world. A 150ft high masonry dam, with 200ft of foundations below the river bed, a mile and a half long, will be built to store 12,000,000 acre feet of water. The two canals which will take off from the dam on either side will irrigate an area of 600,000 acres in the dry tract above the Godavari delta and will also augment supplies to the existing delta canals, which will bring another 1,000,000 acres under irrigation. The project will further develop 75,000kW of continuous power at the dam site. The cost of the scheme as at present estimated is Rs. 60 crores.

Tungabhadra Project—The construction of this project is being taken up jointly by Madras and Hyderabad. It has as its main feature a concrete masonry dam 8200ft long, and 160ft high across the Tungabhadra, a major tributary of the Kistna. The dam will impound 2,600,000 acre feet of water, which will be drawn in equal quantity by Madras and Hyderabad. The total area to be irrigated in Madras will be 300,000 acres of which 36,000 will be under wet garden crop. In addition, Madras will also generate a small quantity of hydro-electric power. The cost of the project to Madras will be Rs. 10 crores.

Reservoir at Gondikota.—It is proposed to build a reservoir across the Pennar to irrigate 100,000 acres of dry crop on both sides of the river. The scheme will cost Rs. 30 crores. Possibilities of developing hydro-electric power are under examination.

Lower Bhawani Project.—On the river Bhawani, a tributary of the Cauvery, this projected reservoir will irrigate an area of 200,000 acres. The project will cost Rs. 4 crores.

Various schemes for drainage in the Cauvery, Godavari, and Kistna deltas are under investigation.

Orissa

Mahanadi Valley Project.—This project comprises the construction of three dams on the Mahanadi river with provision for power generation and of three canal systems taking off these dams for purposes of irrigation. The first dam will be at Hirakund, 9 miles above Sambalpur, and the others at Tikkerapara and Niraj. The project will extend the perennial irrigation to over 2,500,000 acres in Orissa and adjoining states, and generate 200,000kW of cheap power. The project will also provide navigation facilities and will protect Orissa from the twin spectres of drought and famine.

Machkund River.—To utilise the regulated flow of the Machkund river at Duduma Falls for hydro-electric generation, a joint scheme of the Madras and Orissa Governments has recently been sanctioned. The scheme is expected to meet a peak load of 100,000kW. A dam at Jalaput, capable of storing about 600,000 acre feet of water will be constructed. Minor schemes include small dams and weirs on streams and the improvement of existing irrigation tanks. Fifty-one such schemes, estimated to cost Rs. 70 lacs, have been taken up.

Punjab

Bhakra Dam Project.—Under this scheme a dam, 480ft high, is to be built across a gorge in the river Sutlej at Bhakra; the reservoir so formed will have a useful capacity of 3,500,000 acre feet, sufficient to give a mean discharge of 6600 cubic feet per second for a period of 270 days—the dry part of the year. The irrigation system will consist of 200 miles of lined canals and a network of distributaries, and will command an area of about 4,500,000 acres. The scheme, which is expected to cost Rs. 42 crores, will also generate 160,000kW.

The Nangal Power Projects.—A weir across the Sutlej at Nangal, 42 miles above Rupar, and a lined canal of 10,000 cusecs are included. Situated at intervals along this canal there will be four power houses operated by falls ranging from 50ft to 80ft. The combined capacty of these power houses will be 79,000kW; it will be increased to 138,000kW when Bhakra starts to function. The initial stage of the project including transmission and distribution is estimated to cost Rs. 17 crores. Work on the project has already been taken in hand.

United Provinces

Sarda Hydro-Electric Project.—This project has lately been sanctioned and construction is in full swing. It is expected that the work will be completed by 1948 at a cost of Rs. 5·75 crores. The falls in the head reach of the Sarda canal are being utilised for generating 41,000kW for Nainital, Pilibhit, Kheri and Shahjahanpur districts of the United Provinces and for the Rampur State. A part of the energy will be utilised for tubewell pumping.

Nayar Dam Scheme.—The construction of a 600ft high dam to store 1,400,000 acre feet of water on the river Nayar, a tributary of the Ganges, is contemplated. The supplies will be utilised for supplementing the existing discharge of the Ganges canal, and for generating 100,000kW. Preliminary investigations are nearly completed and construction is likely to start soon. The scheme will cost Rs. 15 crores.

Rihand Hydel Project.—This scheme to impound 9,000,000 acre feet of water, will comprise a dam 250ft high on the Rihand, a tributary of the Sone. This will release a perennial flow of 6000 cubic feet per second, to be utilised for irrigation in Bihar and will generate 150,000kW. It is expected to cost Rs. 6 crores and will take four years to complete.

Ramaganga Dam Project.—This dam will impound 2,200,000 acre feet in the Ramaganga valley. The dam will be 340ft high across a gorge in the river. The scheme will generate 50,000kW, and is expected to cost Rs. 14 crores.

Lalitpur Reservoir.—About 80,000 acre feet of water are to be impounded by a dam in the Shazad Nadi, near Lalitpur in the Jhansi district for extension of irrigation on the Betwa canal system. The scheme will cost Rs. 27 lacs, and extend irrigation to 26,000 acres.

Nagwa Dam.—A dam on the Karamnasa, about 3 miles above Silhet, which will cost about Rs. 33 lacs.

These projects are likely to cost the Indian people several hundreds of crores. But it is useful to remember that the existing irrigation works, which have cost about 156 crores, yield double that figure every year. These irrigation works, big as they are, utilise only 6 per cent of the available water strength and cultivate only 12 per cent of the cultivable area. The new projects will add 25,000,000 acres of irrigation to India's existing 20,000,000, and add about 4,000,000kW of hydro-electric power to the existing paltry 500,000. In terms of tangible benefits, Indians can look forward to morefood and clothing, electricity in villages and for village industry and other advantages which follow in its wake.

The Future of Steam Locomotives*

By C. R. H. SIMPSON, A.I. Loco. E.

IT is not a simple matter to forecast accurately the development of any piece of mechanism and the locomotive is no exception: the task becomes an easier one if the forecast is limited to the near future—say twenty years or so ahead—and confined to this country. It is generally within these limits that it is proposed to keep this contribution to the symposium although some references are necessarily made to overseas practice.

In recent years intensive experiments have taken place both with locomotives in the Stephenson tradition and with those of unorthodox types incorporating unusual boilers, unusual engines (for example, multi-cylinder individual axle drive or turbines), or a combination of both exceptional boilers and engines. Generally the departures have resulted in increased complication in construction with its almost inseparable complement of increased maintenance and in some instances more difficult operation has accrued. Germany and France have beeen among the countries particularly to the fore in experimental work and it is significant that after extensive experience with various forms of the steam locomotive both countries have arrived at the conclusion that the increased complication cancelled out any advantages. It is essential to retain the great advantages of simplicity of construction and operation if the steam locomotive is to compete successfully with other forms of motive power and it may be concluded that it will also retain its present form in principle in this country although considerable development in detail may be anticipated.

Broadly speaking, there are six directions in which future development could take place, these are by an increase in (1) speed, (2) power, (3) reliability, (4) availability, (5) the employment of new methods of construction and operation, (6) enhanced thermal efficiency. Obviously to an extent, these factors are related. Considering them in this sequence it is improbable that any substantial increase will take place in speed; existing locomotives are fully capable of very high speeds and the difficulty of working trains at such speeds is that of fitting them in on the tracks already carrying a comparatively intensive service.

The power of modern locomotives is sufficient for all requirements likely to exist for some time ahead. The time has arrived when greater powers cannot well be utilised due to the capacity of platforms, running loops, &c., being fixed. Locomotives already exist in this country capable of producing a cylinder horsepower of over 3500, and any development in this direction is likely to be in an increase in horsepower at higher speeds. Should a demand exist in the future for a considerable increase in power there is only one direction in which the locomotive can expand, *viz.*, lengthways. The two surviving designs of articulated locomotive, the Beyer-Garratt and "Mallet," have proved very successful. It is not always realised that articulated engines can be designed for high-speed operation and locomotives of the former type have operated passenger trains at speeds up to 80 m.p.h.

Reliability and availability are obviously closely related. Much has already been done to promote reliability not only in design and construction but also in the organisation of maintenance.

Availability is undoubtedly the direction in which the greatest scope lies, and a great deal of work has been and is being done in order to increase this. If the steam locomotive is to continue to compete with other forms of traction it is essential that it should possess greater availability which is one of its competitor's strongest points. Unless utilisation is possible, availability loses much of its value. Overall utilisation is probably lower than it is generally realised. Even, however, if utilisation cannot be increased, an improvement in availabilty will result in any given amount of work being done with a smaller stock and a saving in the cost of preparation and disposal.

Regarding alterations in construction and considering first the boiler, the trend is to carry higher pressures which will in some instances involve the use of special steels; welding will play an increasing part in boiler construction, especially for fireboxes, and screwed stays may be replaced by plain ones welded in. To increase availability and reduce the time of preparation —which is in itself an important contribution to availability—rocking grates, self-cleaning smoke-boxes and hopper ashpans will be more generally used. Treated water will be increasingly employed. Steel fireboxes will be utilised more and the fitting of thermic siphons on a larger scale is visualised. It is likely that oil-firing will ultimately become extensively employed purely on its merits, assuming that supplies remain available for such purposes.

Continuous development of accessories will take place and the fitting of soot blowers, sand guns and power-operated fire-doors will become more general on engines where coal-firing is retained.

So far as the engine is concerned, the large scale application of roller bearings is likely. Alloy steels and even high-duty aluminium alloys will probably be utilised more for rod and motion work. Poppet valves will have an increasing application.

The frame is by no means a trouble-free component in many classes of locomotive and developments may be looked for here. Now that wide fireboxes are utilised on a large scale in Britain, one of the major objections to the bar frame, i.e., restricted width of a box fitted between the frames, is no longer applicable. The frame used on the Southern Railway "West Country" Class, in which the centre line of the axle-box falls on the centre line of the frame, is one which may well have an increased application.

Considerable improvements have been made comparatively recently in front end design and it is considered improbable that any drastic changes will be made in cylinders except in the substitution of poppet valves for piston. The possibility of compounding cannot be ruled out, the objection of increased complication no longer holds good in view of the fact that more than two cylinders are already fitted to many modern locomotives. Fuel is now so expensive that compounding has become a much more attractive proposition than formerly.

Small gains in thermal efficiency will be achieved but probably incidentally in obtaining other ends, e.g., poppet valves will be fitted to obtain increased mileage without attention, and will increase thermal efficiency due to their keeping steam-tight better than piston valves. The days have long since gone when a 35 per cent saving in coal and water consumption could be obtained by the fitting of a single component, as happened at the advent of superheating.

Let there be no doubt in the minds of all those interested in the efficient and up-to-date operation of railways that the steam locomotive in an improved form will continue to be the backbone of railway motive power.

* Abstracted from a "Symposium on Railways," at the Junior Institution of Engineers on Friday, Jan. 16, 1948

J. Samuel White and Co., Ltd., Jubilee

THE year 1948 marks the jubilee of the firm of J. Samuel White and Co., Ltd., it being fifty years on February 8th since the present limited company was formed. In 1898 on this date the shipbuilding and marine engineering business carried on by John Samuel White in East and West Cowes, in the Isle of Wight, was converted into a public company. At that time, the firm, as a private concern, had been in existence for about 150 years, the original works being situated at Broadstairs, where they were probably founded by John White in the early 1700's. Between 1800 and 1801 Nye's Yard at Cowes was taken over and fifteen years later the Thetis yard was built and the drydock for taking ships of 800 tons.

Since 1898 the firm made no difference in its management, which was continued under the guidance of John Samuel White, who died at the age of 76 during the 1914-18 war, and in 1919 it ceased to be a private company and became a public company. In that war much could be written of its activities in the construction of destroyers, "P" boats and even submarines. In the '20's and '30's the firm, in common with other shipbuilding yards, experienced variable fortune, but in those years its ability to acquire foreign naval contracts did much to alleviate the situation.

At the outbreak of war in 1939, the yard was fully occupied with naval work, and production was speeded up. In 1942 the small town of Cowes was attacked by bombers during the night of May 4th in two separate raids. While that attack was less effective than it could have been, the firm suffered heavily. Alternative arrangements were made to carry on the work of the departments destroyed, and the delivery of ships, then sorely needed, was hardly affected. Twenty-five destroyers were delivered during the war, and in the boat-building section of the yard, three hundred craft of various types were built. The engine works produced all the machinery for the destroyers and other vessels, whilst the aircraft department made components and sub-assemblies for Spitfires and other types of aircraft. A dispersal factory was established at Warminster, which also served as a storage centre for vital drawings. One of the most important developments during the war was the production of the pre-fabricated, all-welded destroyer, H.M.S. "Contest," the first all-welded ship of its class to be built. A wholesale change in yard lay-out, equipment, and construction was necessitated by this development, and its success was confirmed by the decision of the Admiralty to build all destroyers in the all-welded manner. With the coming of peace, the firm changed over to merchant ship construction, and it is at present fully occupied, much of its output being for export. The present chairman and managing director of the company is Mr. J. A. Milne, M.I.N.A., and under his control a great deal of modernisation and re-equipment has taken place with the object of keeping the firm abreast of modern production requirements.

METAL MANUFACTURING FIRM'S SILVER JUBILEE.—The silver jubilee of E. and E. Kaye, Ltd., non-ferrous metal manufacturers of Ponders End, Middlesex, has just been celebrated. The firm was established in December, 1922, and at that time specialised in the drawing of high-conductivity copper wire. In the succeeding years, however, the range of the firm's products has widened to include copper wire and strip, aluminium and light alloy extrusions and tubes, and magnesium powder. To provide for these developments, the company has added considerably, of course, to the factory space which it occupied at the time of its foundation.

Metallurgical Topics

Stress Concentration and Fatigue Failures

By Professor Dr.-Ing. O. FÖPPL[1]

ON pages 398–399 and 421–422 of THE ENGINEER of May 9 and 16, 1947, under the above title, Professor S. Timoshenko reported on the extremely favourable results obtained in the U.S.A. on crankpins of locomotives by the application of the surface compression procedure originally evolved in the Wöhler Institute, Brunswick. This process (English Patent 315,216), which I referred to for the first time in the journal *Maschinenbau*, 1929, page 755, appears at present, thanks to the publications of Timoshenko, Horger, Maulbetsch, Sachs, &c., to be receiving the recognition which is due to it. The predictions which I made in the article quoted have been fulfilled. "With the existing results of trials, a great field of operation is opened up to industry for increasing the endurance of specially highly stressed components. . . . The appropriate compression processes for crank pins, crank webs, cylinders or screw threads must be perfected." All my endeavours to introduce the compression process into Germany—and I have, by this time, written at least thirty publications on the theory, results of trials and prospects—were ineffective. Now, for the first time, twenty years after the application for the German patent, the significance of the process in raising the endurance limit of highly stressed parts has, thanks to the endeavours of the Americans, been recognised.

In view of the great success obtained with the new process, which has recently aroused interest in Germany, it becomes important for its theoretical basis to be exhaustively examined. The detailed statements of Professor Timoshenko are, therefore, warmly to be welcomed; but I must specifically refer to some points which are still not clear.

Strains and stresses produced by surface compression are given by Timoshenko in Fig. 3 of his paper, here reproduced as Fig. 1. In the journal, *Metalloberfläche*, 1947, page 133, I have indicated the axial changes in length which result from etching away the outer layers. The stresses in the tangential and axial direction can be calculated if one makes an assumption about the relation between axial and tangential strain. This is the subject matter of a dissertation by H. Föppl, Brunswick, which will shortly be published as Part 41 of the *Mitteilungen des Wöhler-Instituts*.

Fig. 2 is a reproduction of a diagram from my paper in *Metalloberfläche*, 1947, page 133. The changes in length Δl in micromillimetres are plotted against the thickness of the layer removed by etching. P is the pressure on the rolls, σ_{max} the greatest stress that occurs in the outermost fibres, and t the depth of the worked layer, i.e., the thickness of the layer which has been plastically deformed. If the rod is etched to a greater depth than t, the length no longer changes ($d\ \Delta l=0$). The depth of the worked layer extends to the position marked with a cross in each curve in Fig. 2. It is possible then to calculate the distribution of stress, in relation to the radius r, in the surface-compressed layer from Fig. 2.

In my measurements I have obtained compressions at the surface two to three times as great as those found by Timoshenko. The differences are accounted for, in part, by the circumstance that my experimental data were obtained on a much harder steel and, in part, by the fact that, by etching, measurements may be carried out much nearer to the outer surface than by boring. The depth of working was, on similar grounds, much less by my measurements than by Timoshenko's. The fundamental difference between my experimental data and those of Timoshenko arises, however, in respect to the stress and strain distribution in the core.

We will, in quite a simple example, viz., in a cylinder, long in proportion to its radius, determine what action the surface compression produces on a middle layer equally distant from both faces. By means of surface compression, the outermost layer b, of which we assume that it has the thickness (r_0-r_2), is deformed plastically, whereas the inner layer a of radius r_1 undergoes no plastic deformation. Let the core and outer layer be separated from one another by an imaginary cut and assume that the layer b, after it is removed from the core, is by some means, plastically deformed, as in surface compression, in such a way that its length l is increased to $l+\Delta l$ and its inner radius from r_1 to r_2. For simplicity, we may assume that each element of the layer b is plastically deformed to an equal extent. If both parts were brought together again we should have the form shown in Fig. 3.

Let us now imagine a radial tension σ_r acting on the inside of layer b and a radial tension σ_r of equal magnitude on the outside of a. The value of σ_r should be such that the space

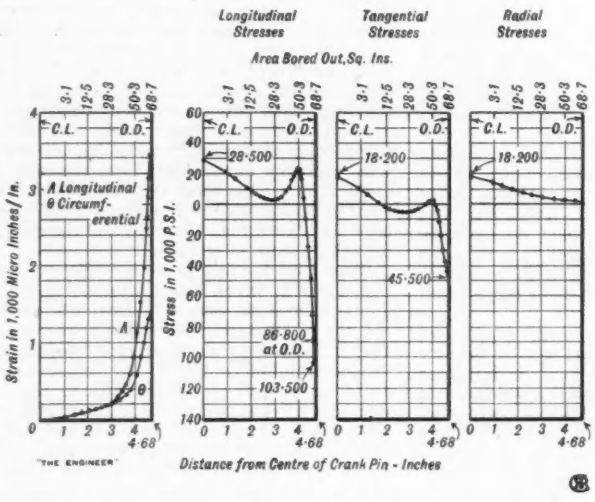


FIG. 1—*Residual Stresses in Rolled Wheel Seats of Full-size Crank Pins (Timoshenko)*

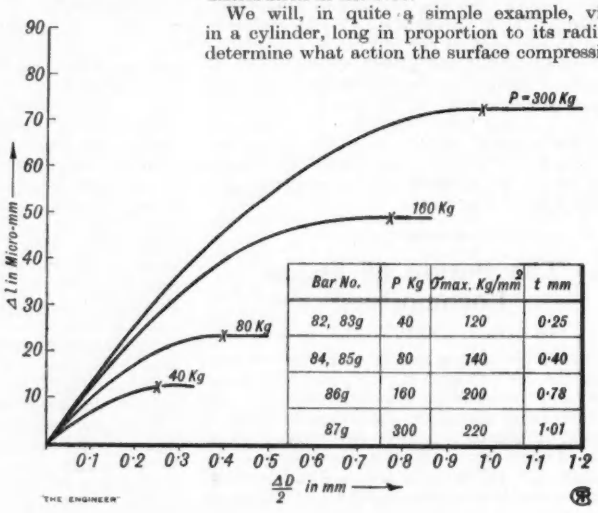

Δl in Micro-mm
P = 300 Kg
160 Kg
80 Kg
40 Kg
Bar No. | P Kg | σmax. Kg/mm² | t mm
82, 83g | 40 | 120 | 0·25
84, 85g | 80 | 140 | 0·40
86g | 160 | 200 | 0·78
87g | 300 | 220 | 1·01
ΔD/2 in mm
THE ENGINEER

FIG. 2—*Etch-diagram. Specimen Surface-Compressed by Rolling; Variable Pressure P with Constant Feed and Finishing Radius. Depth of Working Extends only to Position Marked with a Cross*

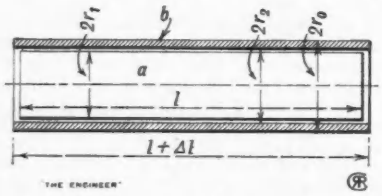


FIG. 3—*Division of Test Specimen by a Cylindrical Cut into a Core a and an Outer Layer b*

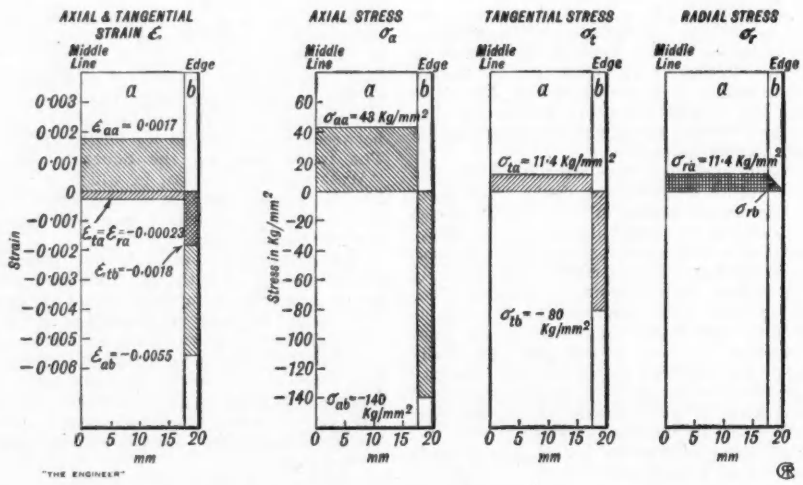


FIG. 4—*Schematic Diagram of the Stresses and Strains in a Surface-Compressed Test Specimen in Dependence on the Length of the Radius*

[1] Director of the Wöhler Institute, Brunswick.

$r_2 - r_1$ shall correspond exactly in a radial direction to the strain associated with σ_r. At the same time we allow a tensile force P to act in an axial direction on the core a and a compression force P on the tube. The force P is of such magnitude that, after the action of both forces, tube and core have the same length, which lies between l and $l+\Delta l$. The two pieces in Fig. 3 are in this way again reduced to a single cylindrical bar, similar to the original bar before compression. The only difference that persists is that the length and radius of the final product have somewhat different values from those of the uncompressed bar. These deviations are naturally minutely small in comparison with the length measurements of the test bar.

The radial stresses in both parts balance one another so that they can be produced, without outside assistance, by internal stresses. The axial force P we imagine to be produced by shearing stresses which act between core and tube. This action may extend to a length about equal to the radius of the test specimen. To the middle part of the core or of the tube are transmitted from both ends, a tensile or compressive stress equal to P/F_1 or P/F_2 respectively. We shall neglect the transverse contraction which influences the magnitude of the stress. F_1 is the cross-sectional area of the core, and F_2 of the tube. We now have a test specimen which exhibits a distribution of stress analogous to that of a surface-compressed specimen. A real difference exists only in so far as in surface compression the greatest plastic deformation appears in the extreme outer layer and that the plastic deformation in the transition from tube to core is not sudden, but gradually diminishes from the highest value at the outside to a zero value at the position $r=r_2$.

The plastic deformation in the tube b actually diminishes gradually up to the core to a zero value. We can, however, bring the assumptions of the imaginary model into better agreement with this variable plastic deformation of the outer layer if we suppose the outer plastically deformed layer of thickness (r_0-r_2) to be subdivided into several cylindrical sleeves which have been plastically deformed to a different extent and then combined in a similar way to that described above. There remains, independent of the number of subdivisions, an undeformed core which behaves exactly as in the simple model shown in Fig. 3, with which we will deal further.

Both the end pieces will be omitted from consideration, since, in them, shear stress transmitted along the dividing wall interferes with the stress distribution. The middle point of the test specimen consists, however, after its reconstruction, of a core a in which a stress $\sigma_a = P/F_1$ and radial and tangential tensile stresses σ_r and σ_t of equal magnitude occur. The stress in the core is thus equal at every position, i.e., in an axial direction σ_a and in a radial direction $\sigma_r = \sigma_t$.

The stresses in the tube b are, on the one hand, the compression stress σ_a of constant magnitude, and on the other hand a tangential compression stress σ_t and a radial tensile stress σ_r whose magnitudes are dependent on the radius. If the layer $r_0 - r_2$ is very small compared with the radius r we can regard σ_t as constant. σ_r diminishes from the value $\sigma_{r_1} = \sigma_{r_2}$ at the position $r=r_2$ to zero at the position $r=r_0$.

In order to calculate the stress distribution, however, attention must be given to the transverse contraction. A stress diagram is obtained which, in principle, has the form illustrated in Fig. 4. By taking into account transverse contraction, the relative changes of length in the core are constant, whilst in the tube they are dependent on the radius. Likewise, as already noted, the stress distribution in the tube of the imaginary model is different from that of the actual surface-compressed cylinder. In the core, however, both model and practice are in agreement. A correct picture of the stresses and strains produced by surface compression can only be obtained if the stresses σ_a, σ_r and σ_t for the core, which are independent of r, are obtained for the core. There is here a fundamental difference between our own data and those of Professor Timoshenko, which, in the interests of the subject, should be made clear. The fact that we in the Wöhler Institute, Brunswick, have obtained our data by etching the surface and Professor Timoshenko in U.S.A. by boring out, does not afford a sufficient explanation since the actual stress distribution must be independent of the manner in which it is measured.

Torsion-Bar Springs

THE successful use of torsion-bar suspension springs in automobile construction is very largely a question of suitable material. Failure by fatigue is the main danger to be guarded against, and the safety of operation of the torsion-bar depends to an important extent on the steps taken to increase the fatigue life of the spring. In recent years the importance of the effects produced in a variety of engineering components by shot blasting, roller peening and other forms of surface deformation have been widely recognised. In an article in *Automobiltechnische Zeitschrift*, Dr. O. Föppl[2] describes how the use of torsion-bar suspension springs in German tanks led to exhaustive researches on the best type of finishing treatment designed to introduce surface compression with the object of raising the resistance of the spring to alternating stress. Dr. Föppl had a special interest in the progress of this work because he had, as early as 1929, secured patents (all of which have now expired) in six different countries, based on the recognition that the surface of a machine part or structural component, which is subjected to alternating stress, is made more resistant to fracture by compressing it either, for example, by light blows of a ball-headed hammer, or, if the article will go in a lathe, by working the surface by means of a ball-pointed tool.

The object of the treatment was thus quite different from that of Hultgren's process of cold working hardened steels (e.g., ball bearings) to increase their surface hardness, and later experience has shown that the principle is of the highest importance to technical progress.

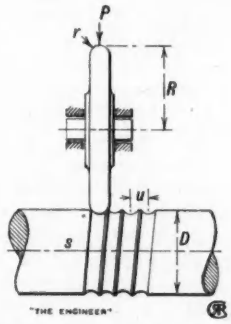


Diagram of Roller-Finishing Treatment

Many highly stressed machine parts benefit by such treatment. The type of surface working that is most suitable has to be determined for the part in question. The position at which fatigue failure is known by experience most frequently to originate must have special attention.

Roller peening, the development of which is due mainly to American workers, was the method adopted for German tanks and is now being used for civilian vehicles. It is the method dealt with in Professor Föppl's article, and is also described in the B.I.O.S. report on "The German Spring-Making Industry."[3] The torsion-bar is rotated at 450 r.p.m. while diametrically opposite spring-loaded rollers (if necessary, several pairs spaced at 6in intervals) move laterally along the parallel part of the bar. The rollers are made of heat-treated chromium-vanadium steel having a Rockwell hardness of 63–65. They are disc-shaped with a curved peripheral pressing surface (see diagram) in which $R=10$mm to 20mm, $r=0{\cdot}5$mm to $2{\cdot}0$mm and the pressure $P=20$kg to 200kg, according to the size and the material of the torsion-bar. The feed u amounts to $0{\cdot}1$mm to $0{\cdot}8$mm, and the surface depression extends to a depth of $0{\cdot}1$mm to $1{\cdot}0$mm.

The load-bearing capacity for alternating stress is raised by 40–80 per cent in soft steel and 70–100 per cent in spring steel. The treatment is specially effective when there is a fretting effect at the clamping position by which the endurance of a material which has not been surface compressed is known to be markedly reduced. After rolling, a 15mm diameter bar may be loaded at least 75 per cent higher with no greater risk of failure. The resilience $(\frac{1}{2} E \sigma^2)$ is increased to $(1{\cdot}75)^2 = 3$ times its original value. There is a somewhat smaller improvement in the load-bearing capacity of a bar of larger diameter.

The ends are shot blasted, and at least one German firm formerly employed shot blasting of the whole bar instead of roller peening. Professor Föppl prefers the surface rolling treatment; in his opinion it is absolutely necessary to surface-compress torsion-bars if premature failure is to be avoided, and he foresees that manufacturers who do not take up this process will have to reckon with disappointment and loss.

Residual internal stress is the major factor in producing the desired effect, and in this connection the contribution by Professor Föppl which appears in the present issue is of considerable interest.

Sulphite-Treated Steel

THE use of steels which machine easily is economically desirable, but the introduction of elements which make a material easy to machine may be detrimental to its other physical properties. This is true of the addition of sulphur to promote free machining; the use of high sulphur is only possible when high quality is secondary to good machining characteristics. The greatest advance in the machining of high-grade alloy steels has been due to improved machine tools.

During the last thirty years much attention has been given to the problem of securing the best possible machinability in high-grade steels by modification of composition. The most important outcome of this is probably the development of the leaded steels in which the properties are affected only in so far as transverse tests at raised temperature are concerned. F. O. Johnson,[4] on behalf of the Wisconsin Steel Works, South Chicago, claims that a relatively small percentage of sulphur, added in the form of sodium sulphite, will effect a marked improvement in the machinability of alloy steels and carbon steels containing over $0{\cdot}3$ per cent of carbon. The process was described in 1942 by E. L. Ramsey and L. G. Graper.[5] Sodium sulphite was added to the ladle in amount sufficient to raise the sulphur content of the steel by about $0{\cdot}025$ per cent. From 65 to 70 per cent of the sulphur in the sulphite passes into the steel. A maximum sulphur content of $0{\cdot}06$ per cent is considered desirable. The improvement in machinability is said to be due to a uniform distribution of a sufficient amount of sulphide and to the elimination, by the sodium oxide formed, of silica and alumina inclusions as a fluid slag which rises to the surface.

A comparison of the properties of untreated and sulphite-treated steels showed no consistent differences to exist except in impact values in the transverse direction. In all other physical properties the deviations were both positive and negative, indicating that the effect is less than that produced by other variables. Deviations of transverse impact value were all negative except in one instance. Thus, while increased machinability is not achieved without some (possibly in certain cases unimportant) sacrifice of other properties, it is claimed that sulphite-treatment compares favourably with other methods of securing improved machinability and surface finish.

[2] A.T.Z., No. 4, 1947.

[3] B.I.O.S. Report No. 181, 1945.

[4] *Metal Progress*, October, 1947, Vol. 52, page 565.

[5] American Institute of Mining and Metallurgical Engineers, Technical Publication No. 1476, *Metals Technology*, Vol. 9, April, 1942.

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JANUARY 30, 1948

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REGISTRATION OF ENGINEERS

THERE is no doubt that the public mind is hopelessly confused about the scope of the training and work of the engineer. Many newspapers persistently use the term "engineer" to describe artisans rather than professional men, and quite recently there was a particularly unfortunate use of the term in a prominent B.B.C. programme. Yet in spite of misunderstanding by the public, it is not at all unreasonable to claim that engineers have contributed more than any other profession to the making of the modern world. Without their work, of course, our modern mechanised civilisation would never have come into existence. But the less direct influence of their work has also been immense. Figures quoted by Sir Roger Hetherington in his presidential address to the Institution of Civil Engineers last November suggest, for example, that they have done as much as doctors towards reducing the incidence of infectious disease. Nor, if the modern world has proved to be no Utopia, if increased production has brought unemployment and if the discoveries of science have been used for evil ends, can much blame be placed on the engineer, since he has played singularly little part in the conduct of public affairs. It may indeed be argued that an application of the engineering method, with its integration of theory and practice, to the wider field of human relationships might do much to alleviate the maladjustments from which society suffers.

It is natural that British engineers who come into contact with those of other nationalities should enquire as to the position taken by engineers in their communities, and their standards of remuneration as compared with other professions. Their replies often indicate a point of view quite different to that which exists in this country, a marked respect for the engineer as a professional man, arising from a knowledge of the high standards that he must reach in order to enter the profession. In the United States and Canada, for example, there is no doubt that the status of the profession is high. Engineers are said to be in an advantageous position to secure many of the more important administrative posts in industry and it is recognised that the advice of engineers is valuable in every branch of civic affairs. If North American engineers are questioned as to the means by which the prestige of the profession has been established they will usually answer "registration." By registration is meant a system which confines the practice of a profession to those holding approved qualifications, as is the case in this country with doctors, lawyers and more recently architects. Registration laws govern the practice of engineering throughout North America and in many other countries. The details of the laws vary greatly and so does the effectiveness of their enforcement, but the principle is everywhere the same. It would appear that there is no instance of registration laws being repealed, but on the contrary, there is usually a demand from the engineers concerned that they should be strengthened. Here an Act for the registration of engineers was introduced into Parliament in 1927, but made little progress. Owing to the dissolution of the organisation which had sponsored it, no further steps were taken at that time. The question of registration was fully discussed by the Engineers' Guild, in November, 1946, and more recently by the North Wales Society of Engineers. In both cases many speakers were strongly in favour of legal registration. On the other hand, opponents have argued that it is unlikely that support for a Bill could be found in Parliament; that if one became law it would restrict the liberty of the individual engineer; that popular misuse of the word "engineer" is so ingrained that it cannot be overcome and that the legal definition of "chartered civil engineer," &c., provides an adequate alternative. Supporters of registration claim that the passage of the Architects Act effectively answers the first objection, and that although doctors have been very sensitive to any threat to their own liberty, they regard registration as a protection rather than a restriction. It is argued that the current use of the word "engineer" to describe artisans, although annoying, is less harmful than its use by persons who may have limited qualifications, but who could not meet, for instance, the requirements of the senior engineering institutions. No doubt, employers will always seek to engage fully qualified men, but they may be prepared to offer only a small differential over the salary for which they could obtain a man without these qualifications. If that is in fact the situation then it seems probable that the unqualified man depresses the standard of the whole profession.

Whatever may be the strength of the arguments mentioned above, it is clear that Parliament will not act merely in the interests of the engineer. It must first be shown that registration would serve the public interest. Here it can no doubt be argued that the future of this country depends to a very great extent on its engineering industry and that we cannot afford to set professional standards lower than they stand in other countries. If the history of the Architects Act suggests that such a claim might succeed it also shows that many years of intense propaganda by some effective organisation will be needed to achieve success. The technical institutions, as "learned societies," accept the fact that their charters preclude them from taking a direct interest in these matters, and it is, we think, undesirable that they should become involved in a contentious issue concerned with the status of engineers. It is rather to such a body as the Engineers' Guild that engineers should look for guidance. The Guild has recently secured influential support, and it will no doubt consider very carefully amongst other matters affecting the status of engineers the merits and demerits of registration. Meanwhile it is an encouraging sign that in establishing the new class of "mechanical and electrical engineers," which is intended to serve all Government departments, the Treasury has made corporate membership of the Institutions of Civil, Mechanical, or Electrical Engineers an essential requirement.

CHATHAM HOUSE ATOMIC ENERGY REPORT

IT was a statesmanlike move on the part of the Royal Institute of International Affairs at Chatham House to set up a Study Group to discuss the issues raised by the release of nuclear energy, and in particular to explore its international implications. After an energetic attack on this many-sided problem the study group reached the point at which the issue of a report for the information of the public seemed desirable. That report was recently published. Citizens of the United States are better informed on such matters than those of Britain, so that any steps to improve the position here would be very welcome. The B.B.C. has done what it could to help, as have the British scientists with their mobile Atomic Train Exhibition. Chatham House enlisted the services of some of the leading scientists and technicians in this field, as well as of the representatives of the political world, of historians and of other public men. Amongst those included were Sir John Cockcroft, Sir James Chadwick, Sir George Thomson, Professors Oliphant and Peierls, Lord Hankey, Sir Arthur Salter, Sir Oliver Franks, and Sir Charles Webster—with Sir Henry Dale, late President of the Royal Society, as chairman.

Unhappily at the moment, the problem of the international control of atomic energy seems almost insoluble. Despite earnest efforts the U.N. Atomic Energy Commission has not yet succeeded in arriving at an agreed scheme. Such success as it has had in

getting its reports of December, 1946, and September, 1947, passed by ten votes out of a possible twelve sounds better than it really is, since one of the objecting votes is that of the U.S.S.R., which with its veto power can easily prevent action on lines it does not like from being taken. The U.S.S.R. exhibits at the moment little sign of wanting to arrive at any friendly arrangements whatever in the political sphere, and although atomic energy is essentially a technical product, it cannot be divorced from international implications, and hence comes under the general ban. How long this situation will last is a matter for speculation, but it would seem that there is little chance of any break in the clouds until the prospect of American economic help in Europe, and its effect when it comes, are definitely known. If for any reason those prospects should fade, U.S.S.R. action would follow one path; but if, as we hope and expect, they should succeed the Russian attitude would no doubt be very different, and greater progress by U.N.O. might then be expected. Even so, it is a moot point whether full international agreement can really be reached on any scheme offering a water-tight measure of security. Such plans are sure to require the giving up by the U.S.A. of much of its present dearly bought knowledge, and that action can hardly be expected unless the scheme proposed is one which is passed by its engineers as embodying a satisfying degree of security from misuse, whether in the form of sabotage or of open aggression. A partial scheme, not doing quite either the one or the other, might be worse than useless. Indeed, as Lord Hankey, with his wide experience of international negotiation, points out in the last chapter of the Chatham House report, a hastily devised scheme might lead to a greater risk of war than if things were left as they are, that is to say in the hands, for the most part, of the U.S.A.

Use can, however, be made of this inevitable period of delay for further research work in the scientific and engineering field. The Lilienthal proposal for denaturing atomic fuel to render it unsuitable for military use was excellent so far as it went; but it was imperfect technically, because it did not show how to treat the material so that denaturing was irreversible. It will be a happy day when it is discovered how to eliminate this defect; the beneficent uses of atomic energy will then be available without the dread, otherwise unavoidable, of facilitating atomic warfare. A fundamental factor governing the use of atomic energy for power production is the adequacy of the world supplies of uranium and thorium. The output of uranium during recent years may have reached thousands of tons, as is often suggested, though definite figures are never given. Prospecting for suitable ores is active, but the results attained are closely guarded secrets. It has sometimes been suggested as unlikely that the raw material could prove sufficiently abundant to add substantially to our current fuel supplies; but Professor Tilley, who holds the Chair of Mineralogy at Cambridge, estimates in his chapter on "The Geological Distribution of Source Materials" that the average content of the accessible crust of the earth is about 4 grammes of uranium per ton, and about 10 grammes of thorium. On this basis the top mile or two of the earth would contain uranium measured not in thousands of tons but in millions, indeed in millions of millions! Before the war technical interest in the extraction and purification of uranium was slight, but the position to-day is very different. For one thing, the commercial value of the metal is now very much higher and the cost of production of vastly less consequence. Nevertheless, it may prove difficult even from such natural abundance to get all the purified product we want; but practical difficulties such as this are merely another challenge to ingenuity, and of such challenges engineers have never shown themselves afraid. Success cannot be commanded, but enthusiasm and energy together can achieve wonders, as witness the wartime success in the discovery of a technique for the liberation of nuclear energy from such materials.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

SURVIVAL OF THE PADDLE-BOAT

SIR,—We have read with interest the article entitled "Survival of the Paddle-Boat" on pages 568–70 of your December 19th issue, and in particular that portion which refers to the "Talisman." The author refers, however, to the vessel being fitted with *an* eight-cylinder oil-electric set. In point of fact, the "Talisman" has four of these and is rare among all-electric ships in that engines, electrical gear, including controls and propelling motor, were all designed, built and installed by one organisation. We feel it right to point this fact out to your readers.

THE ENGLISH ELECTRIC COMPANY, LTD.

Rugby, January 16th.

TWO-STROKE DIESELS ON THE L.M.S.

SIR,—In an article in your issue of December 26th last, it is claimed that the Brush Diesel Electric Shunter is the first on the British Railways to use a two-stroke engine. As a matter of historical accuracy, it may be worth recalling that in 1934 the L.M.S. acquired a Harland and Wolff shunter having a 170 h.p. four cylinder, two-stroke engine with mechanical transmission through a two-speed gearbox. It also had air starting. In 1943 it was resold to the makers as by that time the L.M.S. had established that a higher horsepower was required and that electric transmission was preferable for the class of work involved.

H. G. IVATT,

Chief Mechanical Engineer's Office,
The Railway Executive,
London Midland Region. January 20th.

INDIAN TRANSPORT

SIR,—Whilst I do not wish to anticipate what Sir Stanley Reed is likely to say on the subject of rail transport in India in the course of his articles on "The Engineer in India," I must say I indulged in a rapid flight of imagination on this score on reading the first instalment of his article.

First, the earliest days of travel in India when the palanquin was the mode of transport; second, the bullock cart on the early roads; third, the first railway trains in the days preceding the Indian Mutiny; fourth, travel by train in India as it existed in the seventies of last century, when one journeyed in four-wheeled coaches adorned with heavy overhanging sunshades and mail trains averaged twenty-two miles per hour, and finally the twentieth century, accompanied by the advent of corridor trains and restaurant cars, together with the double roof, and average speed up to thirty-five miles per hour.

When I was in India in 1919, a boon companion in his choleric moments often said to me, "This is what we have to show for our long reign in India, just this, the roads and the railways," I was gratified for, knowing he was anti-Imperialist, it was a grudging admission on his part that the engineer had done his job well.

My own train journeys in India during the years 1918–1920 covered such runs as Bombay to Poona, Bombay to Calcutta, *via* Jubbulpore, Deolali to Bombay, &c., and my impressions of the broad gauge lines was that in most respects they were second to none in point of operating efficiency, and the point to point speeds of the more important trains was much higher than most people at home realised, speeds of 55 to 60 miles per hour being not infrequent.

On all sides one observed the engineer's handiwork at its best.

NORMAN DUNCAN.

York, January 23rd.

TURN-ROUND OF TRUCKS

SIR,—The recent announcement that no railway truck was at Fort Dunlop for more than 24 hours has resulted in a number of inquiries regarding the system on which we work. This quick turn-round of trucks is so vital a factor in achieving the nation's industrial targets, that I feel you may care to make our procedure more widely known, even although there may be production centres for which it will not be wholly appropriate.

Organisation rather than unloading is the key to our success. Our system has got to be flexible, because, as many of our major lines are imported, there is considerable fluctuation in the number of trucks coming in. Advance advice is received of deliveries about to be made and the position is under the daily observation of the departmental managers concerned, I myself getting a daily report on it.

Between half-past six and eight each morning we take a stock check so that, by 8.00 a.m. the number of trucks to be loaded is exactly known. Our traffic controller has these trucks shunted at once to the points where they are to be unloaded, and simultaneously advices are sent to the heads of the departments responsible for the unloading.

As far as the unloading itself goes, our experience is that it can only be expeditiously carried out by varying the number of gangs of men according to the amount of material to be handled. There are four men to a gang and their leading hand is responsible for the gang's work, the count, and so on. Where conditions allow, men are paid by results; in other cases there is a special flat rate.

It is a pleasure to me to be able to add that everyone on the job is thoroughly alive to the need for unloading and loading as quickly as it can be done. They go to it with a will.

W. W. FOSTER,
General Works Manager,
Dunlop Rubber Co., Ltd.

Birmingham, January 23rd.

SAFETY RULES FOR CHEMICAL WORKS.—The third edition of "Model Safety Rules for Use in Chemical Works" has just been published by the Association of British Chemical Manufacturers, 166, Piccadilly, London, W.1. The rules, which have been revised and extended to incorporate various changes in legislation and experience gained through their use since 1939, have been perused by H.M. Chief Inspector of Factories, who commends them as worthy of careful consideration by all engaged in the chemical industry.

The Anglo-Dutch Submarine Telephone Cable

AS announced in our issue dated December 5, 1947, a new Anglo-Dutch telephone cable, manufactured by Submarine Cables, Ltd. (owned jointly by Siemens Brothers and Co., Ltd., and the Telegraph Construction and Maintenance Company, Ltd.), has been recently laid between Aldeburgh in Suffolk and Domburg in Walcheren. The cable embodies new features which make an interesting comparison with previous designs. It is, for instance, the first public submarine telephone cable to be laid using an air space around the conductor in order to reduce losses. The main points of interest in this cable are the use of Telcothene as the main insulant, the incorporation of an air space surrounding the conductor, and the method of forming this conductor.

Telcothene, a mixture of polythene and polyisobutylene, is extruded around a central conductor to a diameter of 0·473in. Over the solid dielectric six types are applied helically with a copper tape folded longitudinally over them, and this forms the main conductor for transmission purposes. Over the main conductor a circular polythene cord of 0·225in diameter is wound in such a manner as to give an effective air space. Solid Telcothene is extruded over the cord to a total diameter of 1·7in, and the outer or return conductor is formed of copper tapes applied with a long lay. A teredo tape of copper is wound over these copper tapes and the cable completed with jute and armouring in the normal manner. A general cut-away view of the finished cable is given in the accompanying engraving.

Effect of Dielectric Air Spacing

In 1945 attention was called to the need for a cable which, over a distance of 85 nautical miles, would fulfil the following conditions :—The cable was to provide a minimum of one "super group" (i.e., sixty duplex circuits) to be laid on a route not exceeding 50 fathoms in depth and no repeaters were to be inserted (since at this time the submarine repeater was thought to be insufficiently developed). The cable was particularly liable to damage by ships anchors, so that a heavy armouring had to be envisaged. A bottom frequency of 12kc/s was essential to match the transmission and amplifying equipment at the ends of the cable while the equipment could tolerate a maximum attenuation of 100 db.

Assuming the normal frequency band of 4kc/s per circuit, it became apparent that the cable must operate at a minimum top frequency of about 550kc/s—a value so far unheard of for practical submarine cable operation over such a length.

At the time this proposal was being studied, machine limitations were the deciding factors in fixing the maximum diameter of the core which could be manufactured in reasonable time within a 1·7in diameter core. The effect of building an air space around the centre conductor of the coaxial core was studied, and it was found that a comparatively small air space had a major effect upon the characteristics and brought a 1·7in diameter core within the range of possibility from the point of view of the requirements demanded from the cable. In comparing the characteristics of the cores with and without an air space it is necessary to determine the operational requirements. Calculated on the conductor ratio $D/d = 3·59$ for the minimum attenuation of a copper-to-copper coaxial and fixing the inner diameter of the outer conductor at 1·7in, the diameter of the inner conductor becomes 0·473in.

For both air space and solid dielectric cables with conductors of the above dimensions, Tables I and II give comparative values of attenuation at different frequencies, and also the circuit capacities based on a lower frequency limit of 12kc/s, a band width of 4kc/s and a maximum permissible attenuation of 100 db.

Table I.—*Attenuation of 1·7in Cable at 60 deg. Fah. (db per Nautical Mile)*

Kc/s	Air space	Solid
10	0·22	0·26
20	0·24	0·28
50	0·32	0·37
100	0·42	0·50
200	0·57	0·69
500	0·90	1·10
1000	1·28	1·58
2000	1·85	2·32
5000	3·0	3·9

Table II.—*Number of Possible Duplex Telephone Circuits on 1·7in Cable (Assuming Permissible Attenuation 100 db)*

Length (nautical miles)	Number of Circuits: Air space	Solid
20	1380	840
30	660	420
40	390	250
60	180	120
80	105	70
100	65	45
200	15	10

The fact that the solid 1·7in core carries fewer circuits than the air-spaced core and at the same time costs more because of the extra insulating material involved has an interesting bearing on the comparative cost per circuit, as tabulated below :

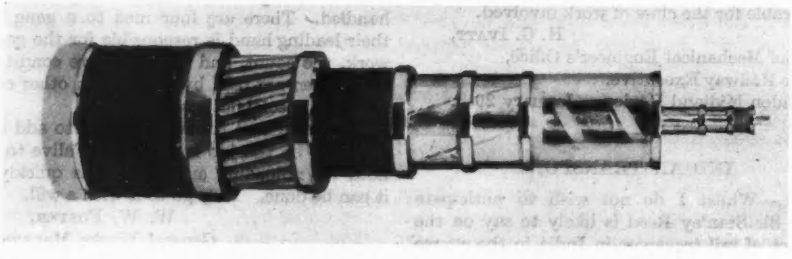
	1·7in solid	1·7in air space
Unit cost	100	93
Number of possible circuits	66	100
Cost per circuit	1·51	0·93

Another comparison of interest is that the solid insulated cable which will carry the same number of circuits as the 1·7in air-spaced cable has a diameter of 2·2in, a very considerable increase in size with its attendant extra weight.

The electrical characteristics of the new cable can be summarised as follows :—

Effective dielectric constant	1·66
Capacitance	0·134 microfarads per nautical mile
Power factor	Approximately 0·0002
Impedance	60 ohms from 10kc/s upwards
Attenuation at 0·55Mc/s	0·95 db per nautical mile

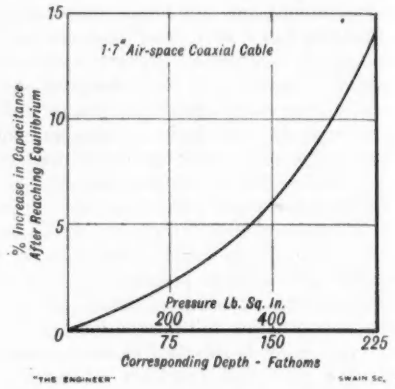
The variation of attenuation with frequency is given in Table I.



AIR-SPACED TELCOTHENE DIELECTRIC SUBMARINE CABLE

The effect of pressure upon the capacitance of the cable is shown graphically herewith. The percentage increase in attenuation is equivalent to half of the percentage increase in capacitance. At a pressure of 200 lb per square inch, the increase of capacitance becomes serious, and the unprotected cable is therefore not suitable in depths greater than, say, 75 fathoms (for each 1 fathom depth the pressure increase is 2·7 lb per square inch).

Two safety devices deserve mention. First, in order to prevent water circulating through long lengths of the air space of the cable should a break or other damage occur, the cable is provided with injection moulded blocks at 750-yard intervals. These blocks or bulkheads have been tested experimentally and shown to resist hydrostatic pressures up to 1000 lb per square inch. Secondly, because of the more rapid and greater temperature changes which may occur in the shallow water at shore ends, this portion of each end of the cable has solid insulation. Thus the possibility of water vapour distilling from low-pressure to high-pressure areas due to temperature change along the length is eliminated.



CAPACITANCE—PRESSURE CHARACTERISTIC OF CABLE

Joints in this type of cable presented a problem since not only must the conductor be continuous longitudinally, but the Telcothene insulation must also be continuous radially. That is to say, in the event of a break, the risk of water creeping along the surfaces of the inner conductor must be completely prevented. After many trials a procedure was adopted involving injection moulding technique which was found by hydraulic tests and X-ray examination to be satisfactory.

Conclusions

The use of this class of cable opens up new fields for submarine communication technique. Not only can these cables be made to carry a super group of sixty duplex circuits over distances of over 100 nautical miles, but when repeaters are inserted at appropriate intervals either the number of circuits or the length of span, land to land, can be increased.

As a result it is not unreasonable to state that all old ideas of the limitations of telephone communication between England and the Continent have been altered. Belgium, Denmark, Holland, Norway and Sweden can now all be linked by multi-channel telephone cables to Britain in such a way that "on demand" telephone calls can be effected. The increase in traffic when "on demand" services are provided is well known to be considerable.

It must be remembered that it is often inconvenient and undesirable for cross-talk reasons to have too many cables entering at one place; consequently, in planning "on demand" services appropriate reserves must be made for future expansion which otherwise may be found to be unduly restricted. In other words, it is essential to envisage large telephone cables in the first instance so as to provide ample circuits for the future. If this important point is neglected the initial effort may be wasted long before the life of the cable has been utilised.

An I.C. Engine Research Exhibition

WE were recently invited by F. Perkins, Ltd., of Peterborough, to see a special exhibition of research equipment which was excellently displayed in the offices of the research section of the firm. The idea behind the exhibit is to foster the co-operative spirit existing between the various departments of the company, and to provide an opportunity of other departments to inspect some of the firm's technical resources, so as to increase the general interest in scientific matters. The display, which was sponsored by the chairman and managing director, Mr. Frank Perkins, was arranged by Mr. M. Vulliamy, the research engineer, and Mr. W. Spoor, the chief designer. The thirty-two separate exhibits were grouped, in sections dealing with the measurement of temperature, speed, vibration, stress, air and fuel consumption, and exhaust gas density, &c. Sixty instruments and test rigs were utilised, and some of the larger apparatus in the test laboratories and workshops was shown by photographs.

Recording Cathode-Ray Oscillographs

An exhibit of much interest was the new recording cathode-ray oscillograph, which has been designed and supplied by Southern Instruments, Ltd., to the requirements of the firm. It is a two-channel instrument, with additional time and event marking tubes, and a separately visible 6in monitor cathode-ray tube. It is employed to record two quite independent functions of engine behaviour, which can be related to time and engine crankshaft position by the third trace, which is controlled by a highly accurate impulse generator giving a signal every one-thousandth, one-two-hundredth, one-fiftieth or one-tenth of one second, according to the requirements of the experiment.

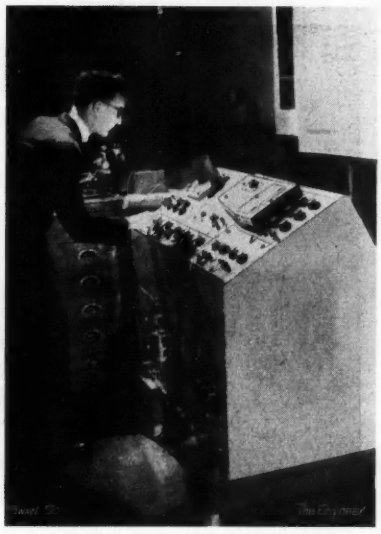
The pressure measuring system has been designed to record pressures of from one two-hundredth lb per square inch to 20 tons per square inch, varying from static conditions up to frequencies of 20,000 cycles per second. By this means, cyclic engine conditions at rates of several thousand crankshaft revolutions per minute may be recorded.

Such measurements are achieved by the use of two specially designed sensitive pressure gauges, which on the application of pressure, frequency modulate the outputs of high frequency oscillators. These outputs are later translated to give voltages proportional to pressure which are amplified and applied to the cathode-ray tubes. Other facilities include electrically operated differentiators with means for calibration. Other uses of the instrument are the recording of engine noise, vibration or stress. By means of two marking tubes and a combined camera, photographic records of all measurements can be taken. An integrating tube is available for other kinds of work, and the monitor tube can be switched in any of the incoming signals. It has also a self-synchronising time-base for the visual checking of phenomena being recorded.

Another type of cathode-ray oscillograph was shown arranged for the measurement of the torsional vibration of crankshafts. The seismatic type of electro-magnetic pick-up for this experiment was shown with a calibrating ring for providing high frequency angular variation of known amplitude. A device specially developed by the staff for permitting vibration free and remote reading of engine testing dynamometers was also on view.

Other Types of Testing Apparatus

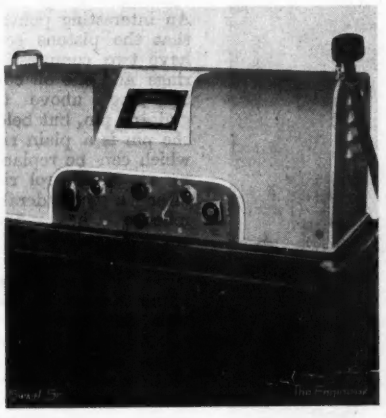
Various types of pressure measuring instruments formed one group, and included the conventional instruments and a remote reading electrical pressure gauge. Methods of temperature reading were displayed in an adjoining exhibit, which included various patterns of thermometers and thermocouple pyrometers, also a demonstration of temperature indicating paints. In the speed measuring section special interest attached to the stroboscopic method of measuring the speed of rotating parts, which was shown by using a flashing lamp type of stroboscope, to indicate speeds of a model engine and an eddy-current driven disc. By



Recording Cathode-Ray Oscillograph

means of electronic circuits, the lamp is made to flash at rates between 600 and 15,000 times a minute.

Another group of exhibits was arranged to show the measurement of air by calibrated nozzles, and by an anemometer inside a cylinder to indicate the speed of swirl, as affected by inlet valves and passages. The analysis of exhaust gases was demonstrated. To aid investigation of fuel mixture, an experiment



Exhaust Gas Smoke Indicating Meter

was on view in which the fuel was mixed with iron carbonyl, causing markings on the piston crown, differing according to the variation of the ratio of fuel and air in the various parts of the combustion chamber.

A useful instrument invented for and adapted to test bed use by the department was the exhaust gas smoke indicating meter, which by a photo-electric cell enables the density of exhaust smoke to be measured and compared on the production test bed.

In the miscellaneous section of exhibits, there was a rubber crankshaft which displayed very clearly the distortion and stressing of a crankshaft under torsional stress.

The Nationalisation of the Gas Industry

At the end of last week there was published by H.M. Stationery Office the text of the Bill to provide for the organisation, under public ownership, of the gas industry in Great Britain. The Bill states that twelve area boards are to be established, the duties of which will be to maintain an efficient, co-ordinated and economical system of gas supply, and to undertake the efficient and economical production of coke. The Boards may manufacture and sell products derived from carbonisation.

A council, to be known as the Gas Council, is to be established to advise the Minister of Fuel and Power on such questions as he may refer to it, and to promote and assist the efficient exercise and performance by the Area Boards of their functions. In carrying out capital development and re-organisation, each Area Board is to act in accordance with a general programme settled with the approval of the Minister of Fuel and Power after consultation with the Gas Council. In connection with such programmes, Area Boards will be required to consult with the National Coal Board if the latter is engaged in carbonisation in their areas; conversely, in such areas, the National Coal Board is to consult the Area Boards on carbonisation programmes.

The Gas Council is to settle, in consultation with the Minister of Fuel and Power, a general programme of research and to secure the carrying out of that programme by itself, or by others, including Area Boards. The Area Boards and the Gas Council will be empowered to manufacture plant and gas appliances, except for export. Furthermore, Area Boards are to make provision for the training and education of employees, subject to co-ordination by the Gas Council.

The Area Boards are to be appointed by the Minister of Fuel and Power and will each consist of not less than seven nor more than nine members. The Gas Council will consist of the Area Board chairmen with an independent chairman and deputy chairman. In addition, a Consultative Council is to be established for the area of each Area Board. Its chairman is to be a member of the Area Board concerned; the other members of a Consultative Council being appointed by the Minister from amongst members of local authorities, and representatives of gas consumers and others interested in gas supply. It will be the duty of a Consultative Council to consider any matter affecting the supply of gas in its area, and to notify its conclusions to the Area Board. The Council will have the right to make representations to the Minister, who may refer any representation on a general matter to an impartial person for inquiry and report.

The Area Boards which are designated in the first schedule to the Bill are as follows:—Scottish, Northern, Lancashire and Cheshire, Yorkshire, North Midlands, West Midlands, Wales, South Midlands, Eastern, North Thames, South Eastern, and South Western. Fuller details regarding the supply areas which these Boards will control, together with an explanatory map, are contained in a White Paper (Cmd. 7313) published by H.M. Stationery Office.

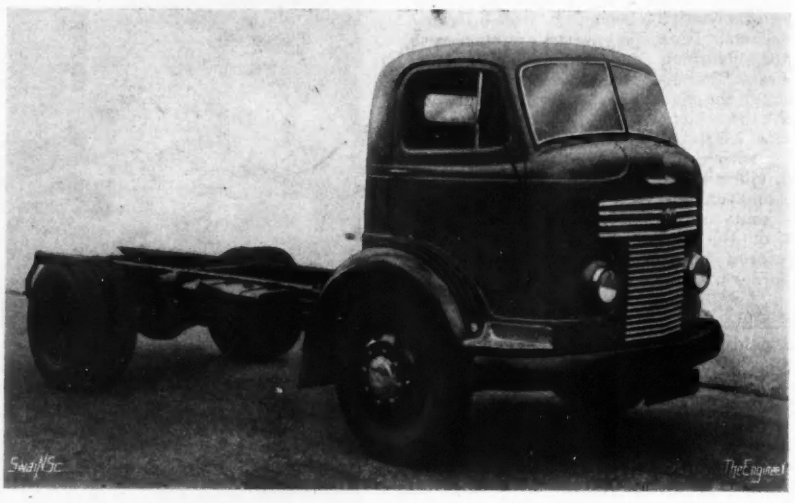
Belfast and County Down Railway.—In pursuance of the policy set out in the White Paper on public transport in Northern Ireland of securing the merger of the principal railway undertakings and that of the Northern Ireland Road Transport Board, agreement has been reached, with the approval of the Government, on a proposal for the purchase of the undertaking of the Belfast and County Down Railway Company by the Board. It is stated that the terms of the proposal are acceptable to the directors of the company and are being communicated by them to the stockholders. The Government is satisfied that the proposal is just and reasonable and accordingly intends, at an early date, to submit for the approval of Parliament the legislation necessary to enable it to be carried out. It is proposed that a more comprehensive measure should be introduced later in the year.

5 to 7-Ton Lorry with Under-Floor Engine

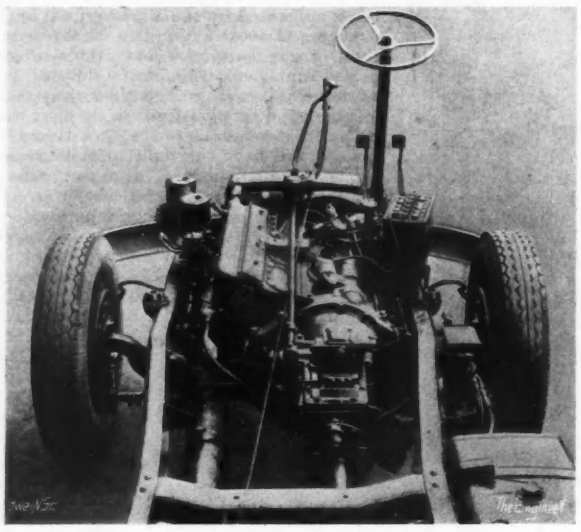
A FLAT or semi-flat type of engine, which can be mounted below floor level, gives several advantages in designing commercial vehicles, notably in connection with good weight distribution on a short wheelbase, a clear floor for the cab across its entire width, and improved conditions for the occupants. Accordingly, it is with interest that we learn of the introduction of two new Commer lorries of 5 and 7-ton capacities, in production by Commer Cars, Ltd., Luton, in which an under-floor engine arrangement has been adopted.

Two accompanying illustrations show the appearance of the new vehicles and the arrangement of the front end of the chassis. The cab seats three persons comfortably side by side, and gives a full forward control position to the driver. Placed below the cab is the engine, and consequently it has been found possible to insulate the cab interior from noise and fumes far more effectively than is possible with the more usual vertical engine, which encroaches on the cab space. For controlling the cab temperature there is a grille at the front. With the shutter of this grille opened a stream of air, which does not pass through the radiator, flows over the engine and under the cab floor, thus carrying away heat rising from the engine. With the shutter closed, cooling air is drawn in from below the cab front, through the radiator and up over the engine, thus heating the cab floor. Adjustment of the position of the grille shutter, it is claimed, enables the cab temperature to be controlled according to requirements.

There is one further point which should be mentioned with regard to the cab before we describe the engine and chassis. Because of the extreme forward position of the controls, it has been found possible on an overall chassis length of 20ft 10in to have a maximum body space, from the rear of the cab to end of the body, of 15ft 11in, or a factor of utilisation of 76 per cent, the body length being one and one-third times that of the wheelbase (11ft 9in). Yet the turning circle has been kept below 50ft. Weight distribution is 30 per cent front and 70 per cent rear, giving approximately equal loads on the six tyres.



LORRY CHASSIS AND CAB



FRONT END LAYOUT

Engine

Engine and clutch form a unit with a four-speed gear-box. The engine is an entirely new six-cylinder design, with overhead valves and bore and stroke of 3⅜in and 4⅜in respectively. Its swept volume is 290 cubic inches (4·75 litres), and it is designed to develop 109 b.h.p. at its governed speed of 3000 r.p.m. Maximum torque is reached at 1000 r.p.m., and amounts to 230 lb/ft, equivalent to a b.m.e.p. of 120 lb per square inch.

The cylinder block and crankcase form a single casting, with the cylinders set at an angle of 66 deg. to the vertical, thus giving substantially a flat unit. The cylinder bores are chrome-finished by the "Listard" process. An interesting point is that the pistons each have two compression rings and one oil control ring above the gudgeon pin, but below the pin is a plain ring which can be replaced by an oil control ring after a considerable mileage has been covered.

Cooling water is circulated by a centrifugal pump driven by belt from the front of the crankshaft, whilst the fan is mounted on an extension of the crankshaft and is driven through a rubber-faced coupling which acts as a torsional vibration damper. Water is directed by jets on to the exhaust ports and other high temperature parts within the cylinder head, whilst the usual thermostat is fitted to bring the engine temperature from cold quickly up to the economic level.

Other points of interest are that the cylinder combustion chambers are machined, giving accuracy of contour, even heat flow characteristics, and reduced tendency towards carbon formation, whilst the full length of each cylinder bore is water-jacketed.

Finally, it should be mentioned that all normal attention to the engine can be carried out by the driver from within the cab, under cover, by removal of the seat cushions and engine covers.

Transmission and Chassis

The clutch is a dry-plate design, 12in diameter, and the four-speed and reverse gear-box incorporates constant-mesh gears for top and third gears. Transmission is through "Layrub" propeller shafts and universal joints, with an intermediate bearing, in the orthodox manner, to a spiral bevel fully-floating rear axle.

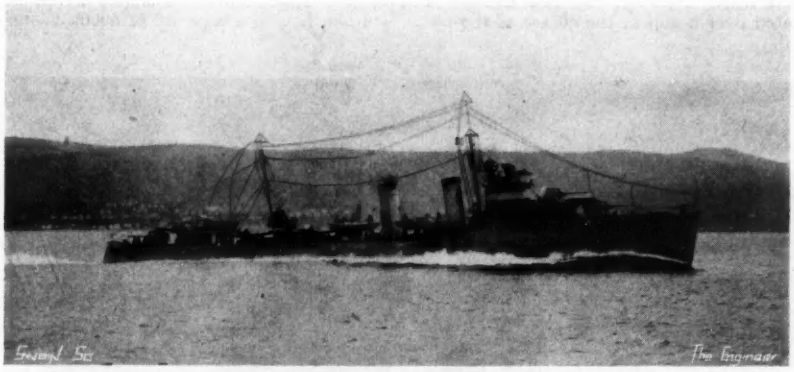
Chassis weight of the 5-ton vehicle is 45 cwt, and that of the 7-tonner 47¼ cwt, with maximum permissible gross vehicle weights of 165 cwt and 204 cwt respectively. Points of difference in the two models are rear axle ratios 6 to 1 and 7 to 1 respectively; tyres 34 by 7, and 35 by 7½; and rear springs, eleven leaves and thirteen leaves respectively for the 5-tonner and 7-tonner. The brake shoe area is greater on the 7-ton model, and a vacuum servo for the brakes is provided for that model, and there are other minor differences. Either model can be fitted for left-hand or right-hand controls.

Technical Reports

A Study of Mechanically Produced Foam for Combating Petrol Fires. Chemical Research Special Report, No. 6. H.M. Stationery Office, Kingsway, W.C.2. Price 2s. 6d., post free 2s. 9d.—Wartime research led to the production of a cheap and effective foam for fighting petrol fires, made entirely from materials available in Britain. This D.S.I.R. report gives full details of the problem, the course of the researches and the results. Large petrol fires cannot be fought with the usual fireman's water jet, because the petrol floats on the water and continues to burn. Foam is lighter than petrol and it can form a blanket on top of the petrol and so extinguish the flames. The type of foam largely used in this country is called mechanical foam; it is produced by churning up air and water with a foam-stabilising agent. By 1939 two efficient foam compounds were available, but they were both expensive and made from imported materials. When war broke out there was a probability of a large increase in petrol fires, and at the same time a shortage of raw materials. In consequence an investigation was carried out at the Chemical Research Laboratory by Dr. N. O. Clark, who is the author of the report. The most suitable agents are stated to be chemically broken-down hoof and horn meal, or glue mixed with materials similar to soapless shampoos or chemically treated blood. The latter is a waste material from abattoirs, and its use for the purpose was discovered at the Chemical Research Laboratory.

Refitting of the Portuguese Destroyer "Douro"

THE Portuguese destroyer "Douro," the first of five destroyers built in 1933 in Lisbon to Yarrow designs, which are now being modernised and refitted by Yarrow and Co., Ltd., Scotstoun, Glasgow, in collaboration with Vickers-Armstrongs, Ltd., on the armaments side, ran her trials recently on the Arran Mile. With a displacement of 1404 tons, a mean speed of 34·05 knots was obtained over two hours, with an output of 28,085 s.h.p. The contract speed after reconditioning was 33 to 34 knots, but it was estimated that with the full power available, a speed of approximately 37 knots could be attained.



DESTROYER "DOURO" BEFORE REFITTING

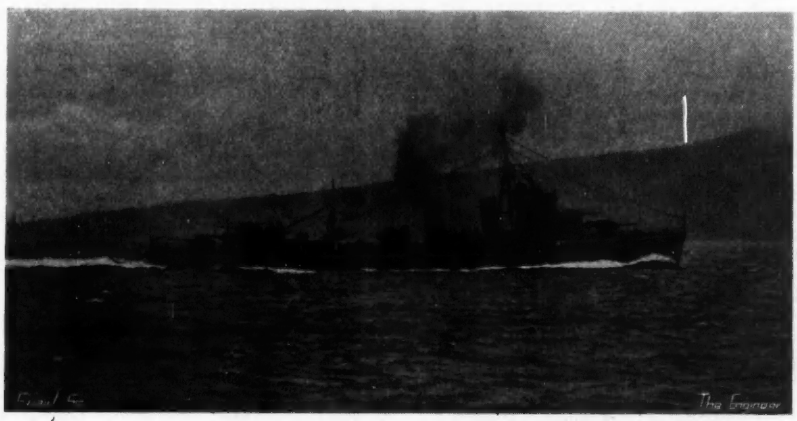
The dimensions of the Portuguese destroyers are :—overall length 323ft, length between perpendiculars 307ft, and moulded breadth and depth 31ft and 18ft 9in respectively. The propelling machinery comprises an arrangement of Parsons geared turbines, taking steam from three Yarrow water-tube, oil-fired boilers, designed for a working pressure of 400 lb per square inch.

In overhauling the ship, all the boilers were retubed, and the main turbines opened up and inspected, also the main gears and condensers. Auxiliary machinery was overhauled and renewed where necessary, and new oil engine-driven electric generators of increased power were fitted. The low power room was also overhauled.

Some changes took place in the main funnels, the after funnel being shortened by a few feet. The illustrations above show the ship before and after modernisation. New outer funnel casings of aluminium were installed, and new refrigerating plant was fitted.

The general refitting and overhauling work, included the inspection of all steelwork and replacement of defective parts, also the renewal of all pipework, and the rewiring of the electrical installation.

Some change may be noted in the arrangement of masts. A steel tripod mast has been fitted, and the lattice mainmast equipped to take the director firing equipment. For ship use a Birmabright motor launch was supplied. Other equipment included a Chernikeeff log of new design, an Asdic installation, type 128AV, a Mark VB plotting table, and a new Echo sounding gear. Overhaul of the wireless equipment included the installation of radar apparatus, types 285 and 291. Among the deck machinery improvements were the fitting of a twin-headed capstan gear, and the supplying of steel anchor cable to replace the former iron cable. Mess spaces were rearranged and fitted with berths and aluminium lockers. In connection with the armament, four 4·7in. guns were modified to take loose barrels, and three 40mm Mark XVI power-worked mountings with type VI gyro-sights were fitted.



DESTROYER "DOURO" AFTER REFITTING

One set of torpedo tubes, 21in quadruple pattern, was modified to permit of firing with air and powder, and a blast shield was fitted.

Some modification to the depth charge throwers took place. Four Mark V depth charge throwers were fitted, with Mark II depth charge racks, and the depth charge rails were overhauled.

Similar measures to those we have described will be applied to the four other destroyers.

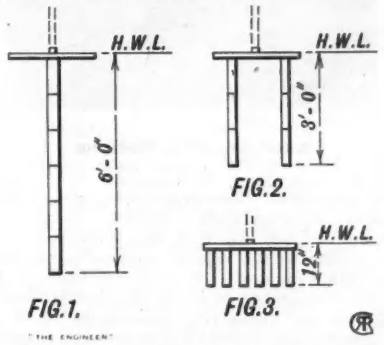
THE RUHR COALFIELD.—Appendix No. 3 to Volume III of the Technical Report on the Ruhr Coalfield, has now been issued by H.M. Stationery Office, price 3s. 6d. It contains full technical details of the Walsum Mine, which has a designed output of 15,000 tons a day.

A Portable Water Level Recorder

A LIGHT compact portable instrument for recording the variation of levels in water storage tanks and reservoirs has recently been designed by Mr. J. Walter, of the Chief Mechanical Engineer's Department of the London Midland and Scottish Railway—now the London and Midland Region of British Railways. This instrument is stated to be particularly reliable and gives full scale readings over varying ranges of rise and fall.

The operation of the instrument is based on the elementary principle of hydraulics, whereby the effective weight of a non-floating body immersed in liquid becomes less by the weight of the volume of the liquid it displaces. It consists of a series of sealed brass tubes suspended in the water from a spring balance. The weight recorded on the balance varies as the water rises or falls up or down the tubes. A recording mechanism connected to the balance actuates a pen over a roll-type chart driven by a clockwork mechanism.

The tube, in this particular instrument, is made of 1in diameter brass tube and constructed in six 12in lengths. Each length is sealed at both ends and provided with screwed connections so that they may be joined together. When the tubes are coupled together end on, as shown in Fig. 1, the instrument will record a variation of from 0ft to 6ft and the movement



ARRANGEMENT OF LEVEL RECORDER

of the pen across the chart will represent 6ft depth of water. When coupled, as in Fig. 2, the range is 0ft to 3ft and the width of the chart represents 3ft. If coupled, as in Fig. 3, the range is 0in to 12in, and in this case the width of the chart represents 12in of water. Thus, by altering the tube arrangement as shown, the readings are multiplied and for small variations in levels clearer records are obtained.

The tubes are screwed to a small crosshead, suspended by a brass chain attached to a hook fixed on the end of a piece of strong gut, which passes over a ball bearing mounted pulley, and joined to the spring balance. It is important that any surplus chain is always hung on the hook and that the full number of tubes is used, otherwise calibration will be upset.

The spring and recording mechanism is mounted in a suitable box, which can be placed at any convenient point on the side of the tank or reservoir. The pulley is carried on an arm, which can be swung out to keep the tubes clear of the sides of the tank.

As the tubes get lighter or heavier as the water rises or falls, they themselves naturally rise or fall, due to the movement of the spring. Notwithstanding this, the total movement of the spring being only $\frac{3}{4}$in, the error in the 6ft range is only 0·5 per cent and in the 12in range 3·1 per cent. The fact that the water in a tank or reservoir is rarely still outweighs any slight inaccuracies and it was not considered necessary to incorporate means of compensation in the recorder.

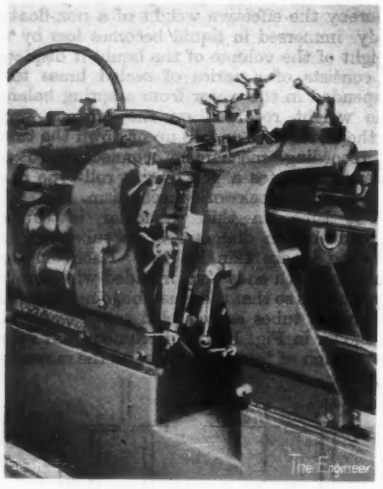
The diameter and length of tubes described were decided upon as they met the requirements for which this particular instrument was needed. By altering the size of the tubes and spring, an instrument could be constructed and calibrated to record variations within any reasonable limits.

A Deep Drilling Machine

In the accompanying engraving we reproduce a photograph of a deep drilling machine for large diameter holes which has been built by Adcock and Shipley, Ltd., of Leicester. It was specially designed for drilling 1 5/16in diameter holes 9½in long through the front axle forgings used on Ferguson tractors.

In the design stages it was decided that for a hole of 9½in step-by-step drilling was necessary, with complete withdrawal of the drills between steps. This is normally a slow procedure involving the use of complicated hydraulic gear, which in this case was ruled out owing to the rate of production required and the comparatively large diameter of the hole. The makers therefore decided to build a machine on which the components could be mounted on a five-station fixture set between two four-spindle drill heads. With this arrangement the fifth station is left free for loading and unloading whilst drilling is being carried out in stages at the four other stations. By suitable setting of the drills and spindles the first pair of drills each penetrate to a depth of 1½in. The second pair of drills increase the depth of the holes by a further 1½in on either side, and the process is repeated in the third stage. At the fourth stage drilling is effected from one side only, and the drill breaks through to complete the hole.

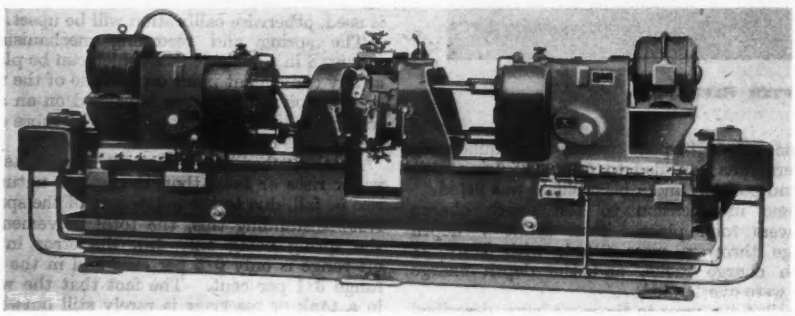
At the end of each stage, when the operator has removed a completed component and replaced it with a blank, he presses a start button. The heads approach the workpiece at a rapid traverse rate and then automatically slow to the drill feed rate. On completion of a drilling operation the heads withdraw at rapid traverse speed and automatically stop. Whilst drilling is proceeding the operator unloads the finished component in the fifth station of the fixture and reloads with a blank. When the heads stop in their rearmost position the operator manually indexes the fixture and presses the start button to repeat the drilling cycle. The system of operation is in this way arranged so that loading and unloading is effected whilst drilling is in progress, and one completed component is produced in the time which would normally be taken to drill one step by the normal step-by-step process.



DEEP DRILLING MACHINE

The machine consists of two heavy-duty, four-spindle drill heads, mounted on the cast iron slides of a rigid fabricated steel bed, which incorporates a sheet metal swarf and coolant tray. Between the two heads, and mounted over a gap in the centre of the bed, is a cradle carrying the rotating five-station work-holding fixture.

Each head is driven by a 15 h.p. motor and drive is taken through gearing to the four drill spindles, which run at a speed of 120 r.p.m. The spindles are bored to accommodate Morse taper drill adjusters, which cater for drill wear. The heads are fed by means of a screw which, for this particular work, is designed to give a 72in per minute rapid traverse rate and a 0·01in per revolution drill feed rate. This feed rate can be altered by changing slip gears.



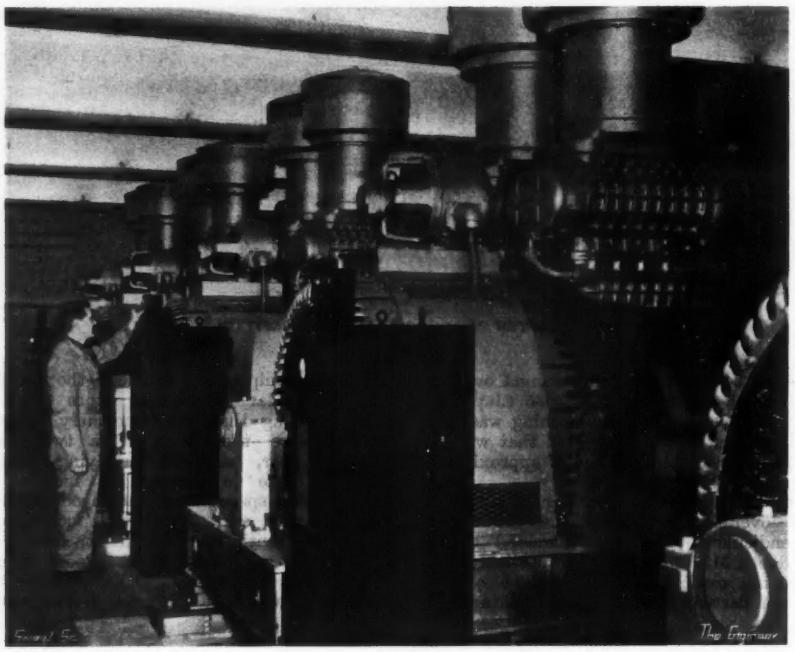
FIVE STATION FIXTURE

As stated above, the work fixture is manually indexed between drilling stages by the machine operator, and each of the five positions is located through a plunger. At each clamping position on the fixture the components are located by means of dowels, which register in previously drilled holes on the components. Clamping is effected by means of two star wheels.

A high-pressure coolant supply fed through the drills right to their points also serves to force the chips and swarf out of the holes.

Vauxhall Motors New Power Station

When in the early spring of last year, the shortage of power first began to make itself felt, Vauxhall Motors, Ltd., of Luton, decided to put down a new oil engine-driven power station, having a capacity of 5000kW, making it one of the largest of its kind in this country.



GENERATING PLANT

The new plant was designed to meet up to 40 per cent of the firm's power requirements, and to operate at twenty-four hours each day for a five-day week.

The engines, generators and switchgear were ordered in March and April, and shipment from America began in August and continued during the autumn. An interior view of the power-house is given herewith.

By the end of the year, all five generating sets were in full operation. There are five General Motors two-stroke, sixteen-cylinder engines, the cylinders being arranged in two banks of eight. The designed output of each engine is 1440 b.h.p. at 750 r.p.m., the generator output being 1000kW. The main dimensions of each generator unit are: Length 24ft, height 6ft, and width 10ft. The engines are similar to those used in American locomotives, and employed with success for the propulsion of tank landing craft. The sets are mounted upon a solid concrete foundation, 4ft in depth, the foundation of each unit containing 40 tons of concrete. They are insulated from the foundations by rubber inserts.

The lay-out is very compact, and the whole equipment is housed in a house 70ft long by 40ft wide, which allows for the future installation of two more 1000-kW generator units.

Adequate provision is made for combustion air, of which each engine needs 880,000 cubic centimetres per cycle. Conditioned air is delivered to the engine-room at the rate of 100,000 cubic feet per minute. Use is made of the heat from the exhaust gases to provide hot water for process work in the factory.

The plant uses 65 gallons of fuel oil for each engine per hour, making a total at full load of 325 g.p.h. Pool gas oil is used, and the storage tank holds 118,000 gallons of oil.

Iron and Steel Prices

THE Minister of Supply has made the Control of Iron and Steel (No. 62) Order and the Control of Bolts, Nuts, &c. (No. 15) Order, which came into force on January 28, 1948. The Control of Iron and Steel (No. 62) Order consolidates, with amendments, all previously subsisting Orders other than the Scrap Orders, and by it the maximum prices of most iron and steel products are increased.

It also provides for the revision of the authorisation scheme hitherto operated by Form M and other documents. Other provisions are that Form M and other authorisations can no longer be used to replace materials which have been acquired by the disposer through his demolition, &c., of any structure or article, whether those materials have been incorporated in anything or treated or not; small quantity exemptions are revised, and department symbols are revised. The Related Schedules are now known as Deposited Schedules, and constructional steelwork as such is removed from control under the Order.

The Control of Bolts, Nuts, &c. (No. 15) Order increases maximum prices for a limited range of steel bolts, nuts, screws, screw studs, washers and rivets.

The following is a list of Deposited Schedules Nos. 1 to 105, inclusive, lodged under the Control of Iron and Steel (No. 62) Order, 1948, together with an outline of the alterations involved:—

Schedule No.	Product	Remarks
	PIG IRON—	
—	Basic pig iron	Increased by 9s. per ton
1	Hematite pig iron—basis prices	Increased by 9s. per ton
2	Hematite pig iron—Zone Index Book, extra and allowances	No change
3	Foundry and forge pig iron	Increased by 4s. per ton
4	Low-phosphorus foundry pig iron	Increased by 4s. per ton
5	Staffordshire blast-furnace low-phosphorus foundry pig iron	Increased by 4s. per ton
6	Scotch foundry pig iron	Increased by 5s. per ton
7	Cylinder and refined iron	Increased by 5s. per ton
8	Refined malleable pig iron	Increased by 5s. per ton
9	Cold blast pig iron	Increased by 4s. per ton
10	Blast-furnace ferro-manganese	Increased by 6s. per ton
11	Spiegeleisen	Increased by 5s. per ton
12	FORGING INGOTS	Increased by 3s. 6d. per ton
	BILLETS, BLOOMS AND SLABS—	
13	Billets, blooms and slabs for re-rolling	Increased by 5s. per ton
14	Billets, blooms and slabs for forging, drop forging and stamping	Increased by 5s. per ton
15	Blooms to AdmiraltySpecification 38 for Hull and Machinery purposes	Increased by 5s. per ton for large sizes and 6s. per ton for small sizes
16	Tube steel billets	Increased by 5s. per ton
17	Gun billets	No change
18	ALLOY STEEL BILLETS AND BARS	Increased by 5s. per ton for billets, 5s. 6d. per ton for black bars, and 6s. per ton for bright bars
19	ALLOY STEEL WIRE RODS	Increased by 5s. 6d. per ton
20	STAINLESS STEEL AND IRON	No change in basis price, extras for Molybdenum content revised
21	SHELL STEEL	Varying increases, schedule re-edited
22	TINPLATE AND SHEET BARS	Basis price increased by 5s. per ton
23	WIRE RODS	Increased by 6s. per ton
	HEAVY STEEL PRODUCTS—	
24	Heavy steel bars, sections and plates	Increased by 5s. per ton
25	Steel sheet piling	Increased by 5s. per ton
	RAILS—	
26	Heavy rails	Increased by 5s. per ton
27	Light rails	Increased by 6s. per ton
	COLLIERY ARCHES AND ACCESSORIES—	
28	Colliery arches and accessories	Increased by 6s. per ton
29	Pit props	Increased by 5s. per ton
	RE-ROLLED STEEL PRODUCTS—	
30	Re-rolled bars, sections and hot rolled strip	Basis increase of 6s. per ton. Sil. Mang. spring steel reduced by 14s. per ton and size extra revised
31	Cold rolled strip	Increased by 7s. per ton
32	Glazing tees	Increased by 6s. per ton
33	Sash and casement sections	Increased by 6s. per ton
34	Gate channels	Increased by 6s. per ton
	BRIGHT STEEL—	
35	Bright carbon steel bars	Increased by 8s. per ton
36	Bright drawn carbon steel flats	Increased by 8s. per ton
	SHEETS—	
37	Uncoated steel sheets thinner than 3mm	No change in basis price, extras list revised
38	Coated steel sheets thinner than 3mm	
39	Electrical sheets	Increased by 7s. 6d. per ton
40	Cellactite sheets	No change
41	Robertsons sheets	No change
	TINPLATE, TERNEPLATE AND BLACKPLATE—	
42	Tinplates	Schedule re-edited
43	Tinned sheets	No change
44	Terneplates	Schedule re-edited
45	Blackplates	Schedule re-edited
	TUBES, PIPES AND FITTINGS—	
46	Gas list steel screwed and socketed tubes and tubulars	Discounts reduced by ¼ point
47	Commercial quality mild steel hot finished seamless or lap-welded tubes and pipes (gas list sizes)	
48	Commercial quality mild steel hot finished seamless or lap-welded tubes and pipes	Increased by 7s. 6d. per ton
49	Hot finished seamless steel tubes and pipes	Increased by from 5s. to 10s. per ton and extra for tubes made from forged bars increased
50	Steel pipes to B.S.S. 534—16in to 72in nominal bore	Increased by up to approx. 0·8 per cent
51	Hot rolled carbon steel hollows	Increased by 6s. per ton
52	Perkins tubes	⅝in seamless increased ½d. per foot and price established for ⅞in butt welded
53	Loose flange joint and Victaulic joint (shouldered type) tubes and fittings	Discounts reduced by from ¼ to ½ points
54	Hot finished steel boiler tubes, &c.	Discounts reduced for under 2in by ¼ point and for 2in and over by ½ point
55	A.P.I. line pipe	Increased by approx. 1 per cent
56	Steel conduit tubes	Increased by approx. ½ per cent for welded and by approx. ⅝ per cent for solid drawn
57	Cold drawn seamless mechanical tubes	No change
58	Cold drawn seamless steel boiler tubes to B.S. 494	No change
59	Cold drawn Admiralty boiler tubes	No change
60	Cold drawn electrically welded steel tubing	No change
61	Electrically welded steel tubing	No change
62	Aircraft steel tubing	No change
63	Aircraft stainless steel tubes to D.T.D. 207 and D.T.D. 211	No change
64	12 per cent chromium stainless steel tubes	No change
65	Austenitic chromium nickel steel tubing	No price change
66	Austenitic chromium nickel steel tubes for welding	No price change
67	Hot and cold drawn tubes to Admiralty specifications	Hot finished increased by up to approx. 1 per cent. Cold drawn no change
68	Tube and pipe joints	No price change
69	Malleable iron pipe fittings	No price change
70	Vertically cast pipes, spun iron pipes and standard socket and spigot special iron castings	Increased by 56s. 6d. per ton on vertically cast; 4s. per ton on spun and 89s. on special castings
71	Cast iron drain pipes to B.S.S. 437	Increased by 25 per cent
72	Cast iron drain pipe fittings	Increased by approx. 14½ per cent
73	Angle cast pipes for gas and water purposes	Increased by 2s. 6d. per ton
	WIRE AND WIRE PRODUCTS—	
74	Mild steel wire and mild steel wire products	Basis increase of 7s. 6d. per ton; fencing wire, clothes lines and flat wire lists revised
75	Florists' wire	Increased by ½d. per doz. lb
76	Stitching wire	Increased by 7s. 6d. per ton
77	Scaffold lashings	Increase 1d. per dozen lengths
78	Concrete mesh (fabric re-inforcement)	Increased by approx. 1 per cent
79	Brake cable and fine steel strand	Increased by 7s. 6d. per ton
80	Special patented wire	Increased by 7s. 6d. per ton
81	Wire netting	Increased by ½ point
82	Wire nails	Increased by 1½ points
83	Chain link fencing	Increased by 1 point
84	Patented steel roping wire	Increased by 7s. 6d. per ton
85	Locked coil ropes	Increased by 10s. per ton
86	Wire ropes	Increased by 10s. per ton
	FORGINGS—	
87	Steel forgings (joint section No. 11)	No price change
88	Steel forgings—F.F. schedules	No price change
89	Crank axles and parts	No price change
90	STEEL CASTINGS	Increased by approx. 2·7 per cent
	RAILWAY TYRES, WHEELS, AXLES, &c.—	
91	Railway tyres and axles	Increased by 5s. 6d. per ton on tyres and 6s. per ton on axles
92	Wheels and axles for private owners wagons	Increased by approx. 0·9 per cent
93	Railway disc centres and brake van wheels	Increased by 6s. 6d. per ton
94	Wheels and axles for carriages for for home railways	Increased by approx. 0·8 per cent
	SPRINGS—	
95	Laminated railway springs	Increased by 7s. per ton
96	Railway coil springs	Increased by 7s. per ton
	IRON CASTINGS—	
97	Rainwater and soil pipes and gutters (England, Scotland and Wales)	No change
98	Box boundary wall, trough boundary wall, centre and trough centre gutters in 5/16in. ⅜in and 7/16in thicknesses (England, Scotland and Wales)	No change
99	Rainwater and soil pipes and gutters and box boundary wall, trough boundary wall, centre and trough centre gutters in 5/16in, ⅜in and 7/16in thicknesses (Northern Ireland)	No change
100	Box boundary wall, trough boundary wall, centre and trough centre gutters in ⅜in thickness (England, Scotland, Wales and NorthernIreland)	No change
101	Rainwater, soil and gutter connections	No change
102	Cast iron brake drums	No change
	MISCELLANEOUS—	
103	Merchants consolidated price schedule	Re-edited to reflect general amendments
104	Old and waste material for re-rolling and washer punching	No change
105	Extras for delivery to Isle of Wight and Northern Ireland	No change

Industrial and Labour Notes

Economic Disorders and Remedies

In a statement which accompanies the annual report and balance sheet of the District Bank, Ltd., the chairman, Sir Thomas D. Barlow, comments on some of the country's economic disorders, saying that although nobody can deny the gravity of our position, we are perhaps too near current events to assess them dispassionately. Sir Thomas does not think that the present state of affairs can be viewed in proper perspective except as a logical consequence of developments operating over a long period. Mankind, he observes, having applied science to industry, and having thereby created the industrial revolution, was insufficiently conscious of its social consequences.

Yet, although we can clearly see the sequence of past events, the statement goes on to ask, do we realise the economic consequences of our recent actions? When it was imperative that the country should increase its output in order to redress its international trading position and also make good domestic shortages, and when, because of that, there was full employment and full order books, we introduced the shorter working week. What, says Sir Thomas, could have been better calculated to produce an atmosphere of false prosperity, and what could have made it more difficult for others than the well informed to realise the critical situation confronting the nation? Indeed, the statement continues, one cannot but consider whether it was wise, when the country was exhausted by a terrible and prolonged war, to embark upon far-reaching schemes of a difficult and complex character when even their protagonists could only claim that the benefits were of a long-term nature. All are agreed that social security and full employment are desirable objectives, but can they be achieved except under an authoritarian system of direction? An optimistic view, Sir Thomas observes, is permissible, but the difficulties and dangers cannot be ignored.

Leaving aside those aspects, the statement says, there has recently been sent out a realistic directive to industry, which shows that it has been recognised, if all too tardily, how parlous the position is. The Marshall Plan may give us some help, but even if we get this assistance it is, asserts Sir Thomas, the duty of everybody to give full support to all remedial measures, however vigorously applied and however unpleasant they be.

Another point which Sir Thomas makes in his statement is the necessity for a keen analysis of economic problems and for more co-ordinated action in dealing with them. He says that to expand the volume of exports at the expense of domestic consumption is, however unpalatable, an essential policy. But in arresting the deterioration of our balance of payments position, it is so easy to concentrate on an overall cut in imports and by so doing starve industry of vital materials. Similarly, record figures for exports can in the long run be a loss rather than a gain if in their attainment we pay inadequate regard to the type of export, and part with goods having little sterling content of labour, or those which are needed for the production of other important exports.

Exports in 1947

The publication by the Board of Trade of statistics relating to Britain's overseas trade in December—mentioned on this page of our last issue—enables a survey to be made of export achievements in 1947. The total value of exports of United Kingdom goods was £1,137,083,305, compared with £914,698,966 in 1946, and was the highest figure ever recorded apart from 1920. In terms of volume, however, last year's exports were not more than 108 per cent of 1938.

In the first three months of last year, the fuel crisis and the disruption of transport caused by the severe weather resulted in a reduction of exports to about £249,700,000, compared with £268,500,000 in the fourth quarter of 1946. From the second quarter of 1947, however, the upward trend in exports continued, although the interference with production in the early months probably affected the figures throughout the year, and in the last quarter of 1947 the volume of exports was running at 117 per cent of 1938, compared with 111 per cent in the final quarter of 1946.

Machinery exports were maintained at a high rate throughout the whole of last year, and in all classes were considerably above 1938 levels. The most outstanding increases were in machine tools, exports of which were two and a half times as high as in 1938, and in agricultural machinery, exports of which were three times as high as in 1938. The number of new motor cars exported in 1947 was 125,788, or more than double than in 1937, which was the best pre-war year. This upward trend in motor car exports, which began after the end of the war, was interrupted only in the first quarter of last year, and in the last quarter exports were more than 50 per cent higher than a year earlier. Locomotive exports expanded appreciably in the last quarter of 1947, and the total for the year, 42,000 tons, was about 75 per cent above the 1938 figure. Total exports of iron and steel and manufactures thereof last year, 1,877,000 tons, were much the same as in 1938, but were 366,000 tons less than in 1946. Coal exports throughout the year were smaller than at any time since the coal strike of 1926, and the total for 1947 was only 3 per cent of that for 1938.

Wages and Hours

A question addressed last week to the Prime Minister asked what steps the Government proposed to take to prevent increases in wages or reduction in working hours where there was no compensating increase in production.

In a written reply, the Prime Minister affirmed that it was the Government's policy to entrust to organised industry the responsibility for determining terms and conditions of employment. He said that the Government had taken all steps to inform the two sides of industry and the country generally of the full facts of the economic position and of the overriding need for maximum production, while avoiding any action which would increase costs. The reply went on to emphasise the appeal already made by the Prime Minister to workers in all industries and employments not to press at this time for increases of wages or changes in conditions which would have the effect of increasing production costs.

Polish Labour in the Engineering Industry

The Minister of Labour was asked in Parliament last week if the engineering unions had now agreed to the employment of Poles in the branches of industry producing mining equipment. In his reply, the Minister stated that his negotiations with the engineering trade unions were not yet completed, but he regretted that the Amalgamated Engineering Union had informed him that it could not agree to the employment of Poles in occupations with which it was concerned.

In the circumstances, the Minister continued, in view of the urgent need to fill outstanding vacancies in essential work, such as the production of mining equipment, he had found it necessary to issue an instruction to local officers of the Ministry of Labour providing for the submission of Poles where, despite every effort to fill the vacancies, it was clear that no British labour was available.

The instruction to which the Minister referred intimates that energetic steps should first be taken to find suitable and available British labour, and where there is difficulty the assistance of the local trade union branch should be sought. If, however, it is impossible to obtain suitable and available British labour willing to take the job, the employer should be informed accordingly. He is to be advised that if he wishes to employ alternative labour he should consult the local branch of the A.E.U. If, in the result, the local officer of the Ministry of Labour receives a request from the employer for alternative labour, suitable and available members of the Polish Resettlement Corps should be submitted.

The Measurement of Work and Wages

Last September, the Department of Industrial Administration of the Birmingham Central Technical College organised a lecture-discussion course dealing with top-management policies designed to promote increased productivity. It was attended by about 120 industrial executives, and the discussions made it clear that, despite the extent to which ratefixing for payment-by-result systems is carried out, there was considerable room for improvement in the methods generally employed to measure work and wages and to provide equitable standards as the basis of monetary incentives when these are deemed appropriate. It is felt, therefore, that it would be useful to provide an opportunity for studying and discussing current techniques in payment by results, particularly their more general implications so far as the establishment of national work and wages standards is concerned.

To this end a second lecture-discussion course for senior industrial executives is being arranged at the Birmingham Central Technical College, and it will be devoted to a detailed examination of the measurement of work and wages. The course will be conducted by Mr. J. J. Gracie, M.I.E.E., and will take place on six consecutive Saturday mornings beginning on April 3rd. Midland industrialists interested in these lecture-discussions are asked to communicate with Mr. D. H. Bramley at the Birmingham Central Technical College. The fee for the course is two guineas, and applications can only be accepted from industrial executives at the level of director, or factory, design, sales, production, personnel and financial management.

Steel Priorities

An announcement regarding steel priorities was made on Tuesday last by Mr. Douglas Jay, Economic Secretary to the Treasury. He said that manufacturers' programmes included in the original Prime Minister's List would no longer enjoy an automatic bulk priority for all their steel supplies, the relative importance of the demands having been allowed for in allocating the steel available. Priority would in future be limited to individual cases where Departments were satisfied that the application of priority to a given order for steel of a stated type was necessary to avoid a hold-up in some essential production. All claims to which priority authorisations were given would rank equally, and those authorisations would be made against the background of the principal current needs, which, Mr. Jay emphasised, were to expand production for export, to ensure that exporting firms were supplied with components, and to enable basic industries such as coal, steel, electric power, transport and agriculture to achieve their targets. A similar limited P.M.L. priority procedure would apply in the allocation and distribution of iron castings.

Mr. Jay also stated that since little difficulty had been found in ensuring that deliveries of materials other than iron and steel matched allocations, there was now no need to employ any system of priorities in the case of these other materials. There were, too, many manufactured components which were in short supply, but a system of allocation or priority for those items would involve the creation of a large staff and require detailed returns from industry, both of which the Government was anxious to avoid.

French Engineering News

(From our French Correspondent)

Following considerable criticism, a commission was set up by the National Assembly to enquire into the French aircraft industry. It has produced a surprising report. It states that the policy of Monsieur Tillon, Communist Minister of Air, was to produce on as wide a scale as possible, regardless of quality and regardless of the manufacture of spare parts. This meant that France is saddled with a fleet of old machines which, it is pointed out, could be used if the quality of their construction was good, but it is not. Further, no parts exist for replacement. Finally, the report complains that the policy encouraged indifferent construction and this aspect is far more serious than any other.

* * *

Figures recently published for the first six months of 1947 show a monthly production of iron ore of 1,600,000 tons, employing 23,000 miners; 1,000,000 tons were distributed to French mills; the Sarre received 140,000 tons; 380,000 tons were sent to Belgium and Luxembourg; 20,000 tons went to Great Britain and 7000 tons were sent to Holland. At the end of June ore stocks stood at 8,700,000 tons. Over the same period 2,393,000 tons of iron were produced with sixty-six furnaces out of 186 existing in France. Steel production was 2,912,000 tons, of which half was Thomas.

* * *

Owing to the difficulties prevailing at the time, the Steel Chambre Syndicale has only just been able to publish its bulletin on the situation of the industry in 1946. It points out that there will be considerably less delay in estimating results in 1947 because the industry is now working fairly normally.

Total production of pig iron in 1946 was 3,444,000 tons; 3,422,000 tons of coke were consumed, of which 2,452,000 tons were supplied by France, a proportion of 72 per cent compared with 68 per cent in 1938 and 53 per cent in 1939. Considerable economy in the use of coke was also effected, 994kg of coke being used to produce one ton of iron, compared with 1045kg in 1938 and 1096kg in 1939. This economy was partly due to technical improvements in handling blast-furnaces, but also to the large-scale use of scrap. For each ton of iron 255kg of scrap were used, as against 105kg in 1938 and 86kg in 1929.

Total steel production for 1946 was 4,408,000 tons; 1,679,000 tons of gas-producing coal were consumed and 253,000 tons of coke. During the year, 59 out of an existing 186 blast-furnaces were in use, 60 out of 93 Thomas convertors, and 63 out of 125 Martin ovens. Total workers employed was 101,789, as against 138,448 in 1938.

* * *

December production in the steel industry has not made the progress expected on November's production. This was due to the disorganisation which was the aftermath of the strikes, both in workshops and transport, and also to the time necessary to get ovens and blast-furnaces restarted. A comparison of figures would seem to suggest that the strikes have deprived France of 200,000 tons of finished steel products and 300,000 tons of crude steel.

* * *

Part of the attempt to overcome the present shortage in production of sheet metal is the construction of a continuous cold rolling mill and a continuous hot rolling mill by the Aciéries de Denain et d'Anain and the Aciéries du Nord et de l'Est, which have combined for this purpose. The hot rolling mill will be installed at Denain and the cold rolling mill at Montataire. The former will be a rather complicated installation and will not be ready before 1950. Production will be over 150 tons an hour, annual production approaching 1,000,000 tons. The cold rolling mill at Montataire will be ready in 1949 and will produce 250,000 tons of finished sheet annually, which will be of high quality suitable for automobile construction.

Notes and Memoranda

Rail and Road

TRAIN COLLISION AT LONDON BRIDGE.—Shortly after 9.30 on Friday morning last, a train from Ore, near Hastings, ran into the rear of an empty train standing at a platform of London Bridge Station, Southern Region of British Railways. The collision caused a coach of the stationary train to be forced over the buffer stops, and as a result a platform bookstall was demolished. One man standing near the bookstall was fatally injured and two railwaymen in the cab of the incoming train died after rescue workers had tried for over two hours to release them.

FUEL EFFICIENCY DEMONSTRATIONS.—Continuing the series of fuel efficiency courses organised during recent years in conjunction with the Ministry of Fuel and Power, the London Midland Region of British Railways is arranging a number of one-day refresher courses on similar lines for boilermen and stokers. The first three courses which have been held at Leeds, Birmingham and London during January, have been running for four or five successive days at each centre, accommodating fifteen men each day. The purpose of the courses, which include instructional film showings, illustrated lectures, and stoking demonstrations by Ministry of Fuel and Power experts, is to explain to boilermen the elementary principles of combustion and the importance of air control on furnace efficiency. Both lectures and firing demonstrations are followed by discussions, in which the students are encouraged to ask questions and state their own particular problems.

Air and Water

INSTITUTION OF NAVAL ARCHITECTS.—The eighty-ninth annual meeting of the Institution of Naval Architects will be held at the Royal United Services Institution, Whitehall, London, S.W.1, on Wednesday, Thursday and Friday, March 17th, 18th and 19th. The annual dinner is to take place at the Connaught Rooms, Great Queen Street, W.C.2, on March 17th, at 7 p.m. for 7.30 p.m. Accommodation at the dinner is limited to 500, and application for tickets—price 17s. 6d. each—may be made by members and include one guest up to February 15th. After that date applications for tickets for additional guests may be made, and if accommodation is available, tickets will be allocated in order of receipt of applications. All applications for dinner tickets should include a remittance and must be addressed to the Secretary of the Institution of Naval Architects, 10, Upper Belgrave Street, London, S.W.1.

B.O.A.C. SERVICES.—The British Overseas Airways Corporation reports that during 1947 it continued to expand its services, and by December was operating ninety-six passenger services weekly inwards and outwards to and from the United Kingdom over a gross route mileage of 125,286 statute miles. In addition, six weekly inward and outward services were being operated between Baltimore and Bermuda; four between Cairo and Nairobi; four between Singapore and Hong Kong; two between Colombo and Singapore; four between Lagos and Kano; two between Lagos and Dakar, and two between Freetown and Dakar. Mail and freight only are carried on the six weekly inward and outward Liberator services between London and Montreal, and on the six fortnightly Lancastrian services between London and Australia. Freight carried during the past year totalled approximately 4,343,360 lb—a substantial increase over the 1946 figures of 3,972,720 lb—and mail carried totalled 3,451,840 lb.

Miscellanea

U.S. STEEL PRODUCTION.—According to the United States Department of the Interior, steel production last year in the U.S.A. totalled 84,000,000 short tons of ingots and castings, an increase of 26 per cent on the 1946 output.

THE LATE MR. H. H. BERRESFORD.—We have noted with regret the death of Mr. Harold Higginbottom Berresford, which occurred suddenly on Sunday, January 18th. He was managing director of the Staveley Coal and Iron Company, Ltd., with which concern he had been actively associated since 1898. Mr. Berresford was a Regional Controller of the Ministry of Production in 1942–43, and was the first President of the Joint Iron Council. He was also a director of Bradley and Foster, Ltd., Doncaster Amalgamated Collieries, Ltd., and the National Benzole Company, Ltd., and just over a month ago was elected to the Council of Sheffield University.

ENGINEERING AND INDUSTRIAL EQUIPMENT EXHIBITION.—An Engineering and Industrial Equipment (Home and Export) Exhibition is to be held at the Royal Horticultural Hall, Vincent Square, London, S.W.1, from March 10th to 24th. It is being organised by "Britain's Best" Exhibitions, 17–18, Henrietta Street, Covent Garden, London, W.C.2.

A FLOATING MACHINE TOOL EXHIBITION.—In our issue of September 19, 1947, we recorded the departure of the M.V. "St. Merriel" with an exhibition of machine tools on board. This exhibition was organised by E. H. Jones (Machine Tools), Ltd., and visits were paid to a number of South American ports. We are informed that the vessel has now returned after a very successful tour, during which practically all the equipment in the exhibition was sold. In addition, a heavy volume of inquiries has been received from Argentine, Brazil and Uruguay.

FILM STRIPS FOR OVERSEAS PUBLICITY.—The Board of Trade has drawn attention to the fact that the information officers at British Missions in most overseas countries are provided with film projectors and with projectors on which film strips can be shown. Representatives of British firms visiting overseas countries are making use of these facilities to show films or film strips dealing with their products. Exporters who wish their representatives to take advantage of this service, where it exists, are invited to communicate with the Export Promotion Department of the Board of Trade, 35, Old Queen Street, London, S.W.1.

RAYON FACTORY IN N. IRELAND.—A new viscose rayon yarn factory is in course of construction for Courtaulds, Ltd., at Carrickfergus, near Belfast. Work on the site began in 1946, but it is not expected that the factory, which is planned to have a floor area of about fifteen acres, will be completed for several years. It is intended to equip the factory with machinery for spinning viscose rayon yarn by a new continuous process. As with all rayon factories, large quantities of water will be needed, and the present estimate of consumption at Carrickfergus is 20,000,000 gallons weekly. Sir Alexander Gibb and Partners are the consulting engineers for the factory and the main contractors are Sir Alfred McAlpine and Co., Ltd.,

COAL EXPORT PRICES.—The Minister of Fuel and Power has made an Order, known as the Coal Prices (Export) (Revocation) Order, 1947, revoking the Coal Prices (Export) Order, 1940, which provided that in determining the price to be paid by the foreign buyer a fixed margin of 3 per cent must be added to the price paid by the exporter to the colliery undertaking. It is explained that the 1940 Order is now unnecessary in the changed circumstances of the nationalisation of the coal industry and the altered conditions upon which the coal export trade of this country is being carried on. The revocation of the Order will leave the settlement of terms for direct negotiation between the National Coal Board and the coal exporters.

BRITISH MADE WHEELED TRACTORS.—The Ministry of Agriculture announces that it is now no longer necessary for intending purchasers to apply to their County Agricultural Executive Committees for approval to purchase the following British made wheeled tractors: Allis-Chalmers B, David Brown, Ferguson, and Fordson Major. Further, the distribution of the Field Marshall and the Minneapolis-Moline "UDS" tractors will be similarly decontrolled with effect from February 2, 1948. Approved permits will still be necessary for the purchase of the Marshall-Fowler tracklaying tractor and all imported tractors, whether wheeled or tracklaying, and for the time being the distribution of all such tractors will be continued under a county quota scheme.

I.E.E. AWARDS.—The triennial award of the Coopers Hill War Memorial Prize and Medal, which fell in 1946 to the Institution of Electrical Engineers, has been made by the Council to Mr. E. C. Cherry, M.Sc. (Eng.), for his paper on "Analogies between the Vibration of Elastic Membranes and Electro-Magnetic Fields in Guides and Cavities." No award having been made in 1946 of the Page Prize for the best thesis in lieu of the associate membership examination of the Institution, the Council has awarded two Page Prizes for 1947. One was to Mr. D. T. Hollingsworth for his thesis entitled "An Account of the Development of the Accessories for a Cable with the Dielectric under Pressure," and the other to Mr. M. K. Taylor for his thesis on "The Transmission of Voice Frequencies by Height Modulated Pulses of Constant Recurrence."

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

Association of Supervising Electrical Engineers

Monday, Feb. 2nd.—LEEDS BRANCH: Great Northern Hotel, Leeds. "Installation and Maintenance in Relation to I.E.E.Regulations," A. Wilde. 7.30 p.m. —SHEFFIELD BRANCH: Royal Victoria Station Hotel, Sheffield. "Slip Ring Motor Starters," J. E. Pegg. 7.30 p.m.

Tuesday, Feb. 3rd.—S.E. LONDON BRANCH: Castle Hotel, High Street, Eltham. "Consumer Service," A. E. Marlow. 8 p.m.—W. LONDON BRANCH: Oddfellows Hall, 186, Hammersmith Road, W.6. "Electrical Observations in America," A. W. Jervis. 7.30 p.m.

Wednesday, Feb. 4th.—N.E. LONDON BRANCH: Mawney's Arms, Mawney's Road, Romford. "Underground and Overhead Distribution," L. R. Perkins. 8 p.m.

Thursday, Feb. 5th.—S. LONDON BRANCH: Café Royal, Croydon. "Electric Contactors and Automatic Control," S. H. Harding. 8 p.m.

Bradford Engineering Society

Monday, Feb. 2nd.—Technical College, Bradford. "Some Problems of Works Plant," H. E. Apps. 7.15 p.m.

Chemical Society

To-day, Jan. 30th.—Birmingham: The University, Edgbaston. "Recent Developments in the Application of Infra-Red Spectroscopy to Chemical Problems," G. B. B. M. Sutherland. 4.30 p.m.

Thursday, Feb. 5th.—Burlington House, Piccadilly, W.1. A Meeting for the reading of Original Papers. 7.30 p.m.

Incorporated Plant Engineers

To-day, Jan. 30th.—LONDON BRANCH: Criterion Restaurant, Piccadilly, W.1. Annual General Meeting. 7.45 p.m.

Institute of British Foundrymen

Saturday, Jan. 31st.—WALES AND MONMOUTH BRANCH: Engineers' Institute, Cardiff. "The Development of Foundry Sand Control," G. L. Harbach. 6.30 p.m.

Saturday, Feb. 7th.—LANCASHIRE BRANCH: Engineers' Club, Albert Square, Manchester. "The Stress Relief of Iron Castings," Report by Sub-Committee T.S. 17 of the Technical Council. 3 p.m.—WEST RIDING OF YORKSHIRE BRANCH: Technical College, Bradford. "Training within Industry for Supervisors," Ministry of Labour Regional Trainer. 6.30 p.m.

Institute of Economic Engineering

Saturday, Feb. 7th.—MIDLAND REGION: Chamber of Commerce, Birmingham. "Estimating for the General Engineer." 2.30 p.m.

Institute of Marine Engineers

To-day, Jan. 30th.—JUNIOR SECTION: Technical Institute, Falmouth. "The Combustion Turbine," J. Calderwood. 7.15 p.m.

Tuesday, Feb. 3rd.—JUNIOR SECTION: S.W. Essex Technical College and School of Art, Forest Road, Walthamstow, E.17. "The Use of Electricity at Sea," C. P. Harrison. 3.15 p.m.

Institute of Metals

Thursday, Feb. 5th.—BIRMINGHAM SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Modern Developments in Hardenability Testing," W. Steven. 6.30 p.m.

Institute of Navigation

Friday, Feb. 6th.—Royal Geographical Society, 1, Kensington Gore, S.W.7. "A New System of Compass Correction," G. N. Harvey. 5.30 p.m.

Institute of Road Transport Engineers

Monday, Feb. 9th.—SCOTTISH CENTRE: North British Hotel, Edinburgh. "The Trend of Development in America," S. Hollands and G. D. Robinson. 7.30 p.m.

Institute of Transport

Monday, Feb. 2nd.—METROPOLITAN SECTION: Livingstone House, Broadway, S.W.1. "Some Cargo Problems of Carriage by Sea,"C. H. Minett. 5.30 p.m. SHEFFIELD CENTRE: Royal Victoria Hotel, Sheffield. "Control Methods of the L.M.S.," E. A. Parnell. 7.30 p.m.

Tuesday, Feb. 3rd.—MIDLAND SECTION: Imperial Hotel, Birmingham. "Exports and the Port of London," P. J. Fossey. 6.30 p.m.

Wednesday, Feb. 4th.—SOUTHERN SECTION: Harbour Board Offices, Southampton. Discussion of the Report on "Education in Management for Transport," 5 p.m.

Thursday, Feb. 5th.—NEWCASTLE GRADUATE AND STUDENT SOCIETY: Bible and Tract Society, Newcastle. "Economics," K. M. Wright. 7 p.m.

Institute of Welding

Thursday, Feb. 5th.—SOUTH LONDON BRANCH: Institute of Marine Engineers, 85, Minories, E.C.3. "New Recommendations for the Design and Fabrication of Welded Structures," H. A. Cadwell. 6.30 p.m.

Institution of Chemical Engineers

Friday, Feb. 6th.—NORTH WESTERN BRANCH: College of Technology, Manchester. Annual General Meeting. "Coal Utilisation," D. T. A. Townend. 2 p.m.

Institution of Civil Engineers

Tuesday, Feb. 3rd.—Great George Street, S.W.1. "Are the Construction Methods of British Civil Engineering Contractors Sufficiently Progressive," For: H. J. B. Harding, Against: G. Kenyon Bell. 5.30 p.m.—SOUTH WALES AND MONMOUTHSHIRE ASSOCIATION: Town Hall, Newport. "The Organisation of Civil Engineering Works," R. W. Horner. 6 p.m.

Thursday, Feb. 5th.—NORTH WESTERN ASSOCIATION: Engineers' Club, Albert Square, Manchester. "Pre-stressed and Post-stressed Concrete," W. E. I. Armstrong. 6.30 p.m.

Institution of Electrical Engineers

To-day, Jan. 30th.—MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. Discussion on "Principles of Instrument Design," opened by D. C. Gall, W. L. Beck, A. F. C. Pollard, and R. d'E. Atkinson. 5.30 p.m.

Monday, Feb. 2nd.—SOUTH MIDLAND CENTRE: James Watt Memorial Institute, Great Charles Street, Birmingham. "Standardisation of Switchgear," D. E. Lambert and J. Christie. 6 p.m.

Tuesday, Feb. 3rd.—MEASUREMENTS SECTION: Connaught Rooms, W.C.2. Social Function. 6.30 p.m.

Wednesday, Feb. 4th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Application of Frequency Modulation to V.H.F., Multi-Channel Radio-Telephony," J. H. H. Merriman and R. W. White. 5.30 p.m. — N.E. STUDENTS SECTION: King's College, Newcastle-upon-Tyne. "The British Grid System," R. K. Edgley. 7 p.m.

Thursday, Feb. 5th.—Ordinary Meeting: Savoy Place, Victoria Embankment, W.C.2. "A Survey of the Telephone Rating Problem," L. C. Pocock. 5.30 p.m.

Friday, Feb. 6th.—SOUTH MIDLAND CENTRE: Grand Hotel, Birmingham. Annual Dinner. 6.30 p.m.

Institution of Heating and Ventilating Engineers

Wednesday, Feb. 4th.—EAST MIDLANDS BRANCH: Gas Showrooms, Parliament Street, Nottingham. "Electrical Energy in the Service of the Heating and Ventilating Engineer," P. A. Moore. 6.30 p.m.

Institution of Mechanical Engineers

To-day, Jan. 30th.—Storey's Gate, St. James's Park, S.W.1. Discussion on "Some Recent Developments in Technique of Radio Valve Manufacture," J. W. Davies, H. W. B. Gardiner and W. H. C. Gomm. 5.30 p.m.

Saturday, Jan. 31st.—NORTH EASTERN BRANCH, GRADUATES' SECTION: Visit to Messrs. I.C.I., Ltd., Billingham. 2.30 p.m.

Tuesday, Feb. 3rd.—AUTOMOBILE DIVISION: Storey's Gate, St. James's Park, S.W.1. "Some Aspects of Petrol-Injection Equipment Development," K. Brook and W. E. W. Nicolls. 6 p.m.

Thursday, Feb. 5th.—SCOTTISH BRANCH: Royal Technical College, Glasgow. "The Gas Turbine and Marine Propulsion," T. A. Crowe. 7.30 p.m.

Friday, Feb. 6th.—Storey's Gate, St. James's Park, S.W.1. "Mechanical Engineering Aspects of Naval Mining," E. C. Wadlow and "Some Mechanical Features in Anti-Submarine Weapons," J. M. Kirkby. 5.30 p.m.—SCOTTISH BRANCH: Robert Gordon's College, Aberdeen. "The Gas Turbine and Marine Propulsion," T. A. Crowe. 7.45 p.m.

Institution of Post Office Electrical Engineers

Monday, Feb. 2nd.—Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. "Modern Approach to Transmission Networks," D. G. Tucker. 5 p.m.

Institution of Production Engineers

Monday, Feb. 2nd.—YORKSHIRE SECTION: Technical College, Keighley. "The History and Development of the Automatic Loom," H. de G. Gaudin. 7 p.m.

Tuesday, Feb. 3rd.—COVENTRY GRADUATE SECTION: Technical College, Coventry. "Industrial Administration," 7.15 p.m.

Wednesday, Feb. 4th.—PRESTON SECTION: Clayton, Goodfellow and Co., Ltd., Blackburn. "Factory Management—New Tools for the New Job," A. J. Charnock. 7.15 p.m. — NOTTINGHAM SECTION: Victoria Station Hotel, Milton Street, Nottingham. "Light Engineering." 7 p.m.

Institution of Structural Engineers

Wednesday, Feb. 4th.—NORTHERN COUNTIES BRANCH: Neville Hall, Westgate Road, Newcastle. "Modern Industrial Design," C. A. Harding. 6.30 p.m.

Junior Institution of Engineers

To-day, Jan. 30th.—39, Victoria Street, S.W.1. "Modern Plastics," C. L. Child. 6.30 p.m.

Saturday, Jan. 31st.—NORTH WESTERN SECTION: The Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester. "Modern Foundry Practice," W. Rawlinson. 2.30 p.m.

Wednesday, Feb. 4th.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. Presidential Address, "Impressions of Power Plant Development in the U.S.A.," L. F. Jeffrey. 7 p.m.

Friday, Feb. 6th.—39, Victoria Street, S.W.1. "Power Transmission in Diesel-Electric Locomotives," T. Schur. 6.30 p.m.

Manchester Association of Engineers

Friday, Feb. 6th.—Engineers' Club, Albert Square, Manchester. "Fuel Efficiency," A. C. Dunningham. 6.45 p.m.

Manchester Statistical Society

To-day, Jan. 30th.—INDUSTRIAL GROUP: Society of Architects, 16, St. Mary's Parsonage, Manchester. "Applications of Statistical Methods in Industrial Chemistry," K. A. Brownlee. 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Feb. 6th.—Mining Institute, Newcastle-upon-Tyne. "Alternating Current for Ship's Auxiliaries," A. N. Savage. 6.15 p.m.

Royal Society of Arts

Wednesday, Feb. 4th.—John Adam Street, Adelphi, W.C.2. "Education for Management," L. Urwick. 2.30 p.m.

Royal Statistical Society

Wednesday, Feb. 4th.—BIRMINGHAM GROUP: Chamber of Commerce, 95, New Street Birmingham, 2. 'The Design of Experiments with Special Reference to the Chemical Industry," K. Brownlee. 6.30 p.m.

Friday, Feb. 6th.—LONDON GROUP: E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, W.C.2. "Quality Control in Europe," Dr. Geiss. 6 p.m.

Society of Engineers

Monday, Feb. 2nd.—Geological Society, Burlington House, W.1. Presidential Address, E. E. Turner. 5.30 p.m.

Women's Engineering Society

To-day, Jan. 30th.—MANCHESTER BRANCH: Visit to Salford Electrical Instruments, Peel Works, Silk Street, Salford. 6 p.m.

Saturday, Jan. 31st.—LONDON BRANCH: Visit to X-Ray Department, St. Bartholomew's Hospital, E.C.1. 2.30 p.m.

Personal and Business

MUSGRAVE AND CO., Ltd., has removed its Bristol area branch to Service House, 14–15, Merchant Street, Bristol, 1.

MR. F. NEIL SUTHERLAND, M.I.E.E., has been appointed general manager of Marconi's Wireless Telegraph Company, Ltd.

THE English Electric Company, Ltd., announces the retirement of Mr. J. A. Osborn, technical adviser in its steam turbine department.

JAGUAR CARS, Ltd., has completed plans for the establishment of a factory in Belgium in conjunction with the firm of Van den Plas.

MR. H. P. R. SCOTT has been appointed joint managing director of Thomas Summerson and Sons, Ltd., and Summerson's Foundries, Ltd.

THE P.D.N. Castle Engineering Company, Ltd., 87, Pembury Road, Tottenham, N.17, has been appointed London area representative of J. Bateson, Ltd., Gibraltar Works, Halifax.

THE Engineers' Guild has established an office at 28, Victoria Street, Westminster, S.W.1 (telephone, Abbey 6511). Mr. W. A. M. Allan, M.I.C.E., continues as honorary secretary.

MR. H. S. CRUMP has been appointed manager of the Manchester office of the Brightside Foundry and Engineering Company, Ltd., at Palatine House, 76, Victoria Street, Manchester, 3.

MR. GEORGE DOW, press relations officer of the Eastern and North-Eastern Regions of British Railways, states that his office is now at 11, Blandford Square, London, N.W.1 (telephone, Paddington 3400).

THE French Line announces that Mr. G. C. Rhodes, its agent-general, will retire on June 30th next, after fifty-one years' service with the company. Monsieur Roger A. Raulin is to succeed him.

MR. J. R. TOMLINSON has been appointed agent in charge of the Cleveland ironstone mines of Dorman Long and Co., Ltd. Mr. W. I. E. Hickman has been appointed agent in charge of the company's limestone quarries, the Burley ironstone quarry, and the Eston mine.

MR. Ellis Hunter, deputy chairman and managing director of Dorman Long and Co., Ltd., has been re-elected President of the British Iron and Steel Federation. Sir James Lithgow, having expressed a wish to retire from the past-presidency, Mr. G. H. Latham, chairman of Whitehead Iron and Steel Company, Ltd., and a member of the Iron and Steel Board, has been appointed to that office. Mr. N. H. Rollason, managing director of John Summers and Sons, Ltd., has been appointed president-elect of the Federation.

MONSANTO CHEMICALS, Ltd., announces the formation of a central engineering department, which will be located in London. Mr. W. M. Cooper will manage the department, the work of which will be assigned to four divisions: chemical engineering, under Mr. M. Buis, B.Sc., with Dr. J. A. Gardner as assistant chief chemical engineer; mechanical engineering, under Mr. O. W. Murray, M.I.Mech.E.; civil engineering, under Mr. R. Adams, A.M.I.Mech.E.; and constructional engineering, under Mr. J. M. Kershaw, B.Sc., F.R.I.C., who will also act as assistant to Mr. Cooper.

THE British Electricity Authority announces the appointment of Divisional Controllers as follows: Mr. J. N. Waite, M.I.E.E., London; Mr. W. C. Parker, M.I.E.E., South-Eastern; Mr. R. H. Coates, M.I.Mech.E., M.I.E.E., Southern; Mr. J. T. H. Legge, M.I.E.E., South-Western; Mr. W. N. C. Clinch, M.I.E.E., Eastern; Mr. W. S. Burge, M.I.E.E., East Midlands; Mr. F. W. Lawton, M.I.Mech.E., M.I.E.E., Midlands; Mr. H. V. Pugh, M.I.Mech.E., M.I.E.E., South Wales; Mr. A. R. Cooper, Merseyside and North Wales; Mr. G. A. Vowles, M.I.Mech.E., M.I.E.E., Yorkshire; Mr. J. C. Mitchell, M.I.Mech.E., M.I.E.E., North-Eastern; Mr. C. T. S. Arnett, M.I.E.E., North-Western; Mr. J. F. Field, M.I.C.E., M.I.E.E., South-East Scotland; Mr. E. J. Edgar, M.I.E.E., South-West Scotland.

A Seven-Day Journal

South-Western Society of Mining Engineers

At a recent meeting of the Council of the Institution of Mining Engineers, consideration was given to an application for federation from the newly-formed South-Western Society of Mining Engineers. The council welcomed the formation of this society, which has now been formally federated with the Institution. The Institution of Mining Engineers was established in 1889, and incorporated by Royal Charter in 1915, by the realisation of the fact that in the pooling of the results of efforts of local societies, the advancement of the science and practice of the coal mining industry in its widest application, the safety, health and welfare of those engaged therein, and the improvement of the status of the coal mining engineer would be more effectively promoted. The Institution is composed of separate societies established in the last century in the various coal mining districts of the country, but it has not hitherto been represented in the South Wales area. With the federation of the South-Western Society of Mining Engineers, the Institution can now be considered to represent the coal mining engineering profession throughout Great Britain. At the time of his death, in August last, Professor T. David Jones was taking a leading part in the formation of the South-Western Society, the first President of which is Mr. T. S. Charlton, Production Director of the South-Western Division of the National Coal Board. Professor J. Sinclair, University College, Cardiff, is the Treasurer, and Mr. R. F. Pescod, H.M. Inspector of Mines in the Swansea Area, is the Honorary Secretary. His address is 33, Lon Cadog, Cwmgwyn, Swansea, and all applications for membership should be submitted to him.

The British Hydromechanics Research Association

The British Hydromechanics Research Association—reference to the formation of which was made in a Seven-Day Journal Note on November 28, 1947—has appointed Mr. L. E. Prosser, B.Sc., A.M.I.Mech.E., as its Director of Research. Mr. Prosser was educated at Luton Grammar School, from where he gained an open scholarship to King's College, London, and after short periods of service with the British Thomson-Houston Company, Ltd., and George Kent, Ltd., he joined the staff of the National Physical Laboratory, Teddington. For the past nine years he has been Principal Scientific Officer in charge of the Fluid Mechanics Section of the Engineering Division of the N.P.L., and is in close association with the work of the Hydraulic Machinery Committee of the Mechanical Engineering Research Board. It is expected that Mr. Prosser will take up his appointment with the British Hydromechanics Research Association early in April, when he will open the Association's offices at 78, Petty France, Westminster, S.W.1. Until that time, the Association asks that all communications should continue to be directed to the Secretaries—Peat, Marwick, Mitchell and Co., 94–98, Petty France, Westminster, S.W.1.

Aluminium Alloys for Shipbuilding Purposes

The Committee of Lloyd's Register of Shipping has issued tentative requirements for the Quality and Testing of Aluminium Alloys for Shipbuilding Purposes, the first regulations of the kind to be published. Lloyd's Register has, over a number of years, been interested in the use of such materials, and in 1931 the yacht "Diana II," built of aluminium alloy, was granted the Society's class. Subsequently, other small craft were constructed of this material. It is stated that with the falling away of the wartime requirements of the aircraft industry, supplies of aluminium alloys are now available for other structural purposes, and considerable attention is being given to the production of larger and thicker plates and sections suitable for shipbuilding. Proposals have recently been approved for the use of these materials in place of mild steel, not only for a variety of structural parts, such as deckhouses, hatch covers, webs and masts, but also for the main hull structure of larger ships. Moreover, experience has shown that, provided certain well-defined precautions are taken, light alloys of this type are suitable for marine conditions. The tentative requirements now issued specify chemical composition of both heat-treatable and non-heat-treatable alloys, the procedure to be adopted in their manufacture and the physical properties required. The regulations are so framed as to permit the approval of light alloys having other characteristics, provided these are considered suitable, and the specification, while acting as a guide to the use of these materials, will therefore, it is hoped, also encourage technical development.

The British Shipbuilding Research Association

The second annual report of the British Shipbuilding Association, covering the year ended March 31, 1947, shows that the Association has proceeded from the stage of planning its activities and beginning work on its research programme to a condition where the work is well advanced. The research programme upon which the Association is engaged includes studies in hydrodynamics, ships' structures, machinery, and performance, and at present activities are divided roughly into two categories. The first category covers work involving the survey and collection of existing information, a matter dealt with mainly by the staff of the Association, and the second category covers work involving experimental investigations. Arrangements are normally made for the experiments to be carried out extramurally by organisations not under the direct control of the Association, such as Government laboratories and university departments. This arrangement, the report comments, has many advantages, not the least of which is that it has avoided at the outset the need for the Association to build and equip laboratories. A further advantage is that it enables the Association to draw upon the personnel, specialised knowledge, experience and facilities available in many fields. Research work placed with universities and technical colleges is, of course, of particular importance when such institutions are situated in the shipbuilding districts or where they cater especially for the industry. Dr. S. Livingston Smith, M.I.C.E., M.I.Mech.E., M.I.N.A., continues to serve the Association as Director of Research.

The Railway Executive Committee

With the vesting of the railways in the British Transport Commission, the work of the Railway Executive Committee has come to an end, and the Minister of Transport, who has acted as its chairman, has sent a letter to Sir James Milnes, the deputy-chairman, expressing appreciation of the committee's services and putting on record some of the main features of its activities. The Railway Executive Committee began work in an advisory capacity in 1938, and rendered helpful assistance in planning the railway wartime organisation and generally in making the railways of this country ready for all eventualities. When war came in September, 1939, the railways were able to go into action with the least possible disturbance of normal services, and as the Government took control, the Railway Executive Committee became the agents of the Minister of Transport. The Minister's letter says that so much of the Committee's work was of a highly secret character that it is still not generally appreciated how much the committee, with its teams of experts, contributed to the preparation and execution of large-scale military and civilian movements. With the end of the war, the Minister's letter continues, the need for co-ordination, so far from diminishing, became increasingly important as the arrears of rolling stock awaiting repair daily increased. Locomotives, as well as wagons, were switched from one part of Britain's railway system to another, irrespective of ownership, and in this and other ways the Railway Executive Committee helped to ease the inevitable bottlenecks and keep essential traffic flowing.

The Road Transport Executive

The Minister of Transport has announced that, following consultation with the British Transport Commission, invitations to become full-time members of the Road Transport Executive have been accepted by Major-General G. N. Russell, C.B., Mr. Claud Barrington, M.I.Mech.E., Mr. George Cardwell, M.Inst.T., Mr. H. E. Clay, and Mr. Archibald Henderson, M.Inst.T. Mr. W. Beckett, Mr. Henry Dutfield, M.Inst.T., and Mr. P. J. R. Tapp, C.B.E., M.Inst.T., have accepted invitations to become part-time members of the Executive. Major-General Russell has been appointed chairman of the Executive. He was first commissioned into the Royal Engineers in September, 1918, and during the recent war he served continuously on the Movements Staff, first with the British Expeditionary Force in France, secondly at G.H.Q., Middle East, where he was Director of Movements at the time of the Battle of El Alamein, and finally in India, where he was Deputy Quartermaster General for Movements. Since the end of the war he has been acting as transport adviser to the Special Commissioner for South-East Asia.

Report on the Derailment at Polesworth

The report has now been issued of the inquiry into the derailment which occurred on the late London Midland and Scottish Railway, on July 21, 1947, near Polesworth. In this accident the 8.30 a.m. express passenger train from Euston to Liverpool was travelling on the down fast line at 65–70 m.p.h., when the engine and fourteen of the sixteen coaches it was hauling became derailed on the outside of a left-handed curve. The engine overturned before coming to rest about 400 yards beyond the point of derailment and the two leading coaches, which were also overturned, were wrecked. There were about 800 passengers on the train and of these four were killed and one died later from the injuries received. Nineteen persons received serious injuries, and a further forty-five suffered from minor injuries and shock. As a result of his inquiries into the cause of the derailment, Lieut.-Col. G. R. S. Wilson found that the track was not in a fit condition for traffic of the prevailing speed and weight, and this was the sole cause of the accident. It was considered in 1946 that the track was approaching the end of its life, and it had been accepted for renewal in 1948, but the extent to which its margin of safety was decreasing in the meantime had been seriously misjudged in spite of warning signs. The point was reached eventually when the holding power of the screw fastenings in eighteen-year-old sleepers was insufficient to withstand the passage of a heavy engine at moderately high speed, and at the same time the fastenings were unfairly stressed by the effect of the side cut rails, which in their turn facilitated the derailment of the leading bogie wheels of the locomotive. Lieut.-Col. Wilson states in the conclusions to his report that responsibility for the continuing fitness of track must rest at all times with the District Engineer, who in this case was out of touch with the position and did not have the support to which he was entitled from the Permanent Way Inspector, who had not appreciated that the side wear of the high rails had been approaching the danger point for some time.

Present Day Locomotive Working in Great Britain *

No. III—THE G.W.R. OIL-FIRED 4–6–0's—Part I

By O. S. NOCK, B.Sc.

THE conversion by the Great Western Railway of a number of locomotives from coal to oil-firing has naturally partaken of topical interest, owing the the economic difficulties through which the country in general is passing. But while direct saving of coal may be a primary reason for the extensive programme which is now under way, oil-firing in itself holds a number of potential advantages in both the running and day-to-day maintenance of steam locomotives. From purely superficial observation it is clear that the Great Western Railway has already achieved a large measure of success with the earliest engines included in this programme, while the more detailed investigation which the author has been privileged to make, through the courtesy of Mr. F. W. Hawksworth, Chief Mechanical Engineer, has revealed many points of particular interest, while amply confirming the favourable impression gained from notes of the punctual running of passenger trains.

At the present time engines of four different classes have been converted :—

(*a*) 2–8–0 heavy main line freight engines.
(*b*) 4–6–0 heavy mixed traffic, "Hall" class.
(*c*) 2–6–0 light mixed traffic engines.
(*d*) 4–6–0 express passenger "Castle" class.

The equipment of the 2–8–0 engines was described in THE ENGINEER for November 16, 1945. These latter have coupled wheels 4ft 7½in diameter, but in applying the arrangement to the 4–6–0 engines with their larger coupled wheels, a modification was necessary. Fig. 1 shows the lay-out as applied on the "Castle" class, and it will be appreciated that the reduced depth between the fire-door and the steel plate entails accurate adjustment of the burner

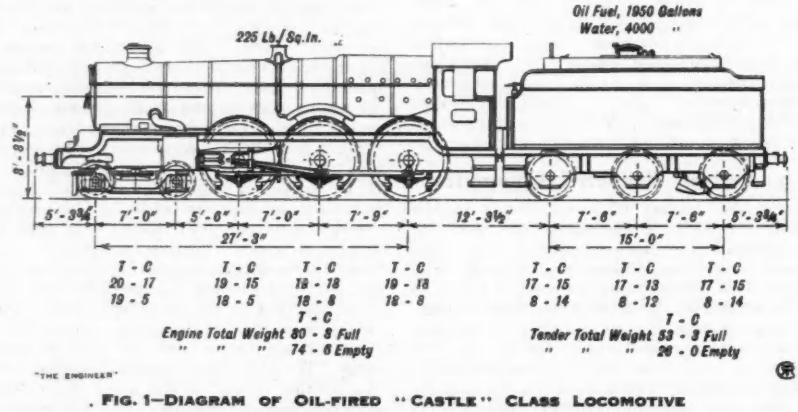


FIG. 1—DIAGRAM OF OIL-FIRED "CASTLE" CLASS LOCOMOTIVE

if the flame is to impinge correctly on the flash wall and not be deflected upwards to the fire-door or downwards on to the plate itself. Fig. 1 shows the oil-fired "Castle" engine and Fig. 2 the oil-fired "Hall."

At the present time the oil-fired 4–6–0's of both "Hall" and "Castle" classes have been distributed so that the largest possible number of engine crews may acquire proficiency in the art of handling them. It is no small tribute to the design and lay-out of the control equipment that a week's training has been found to suffice before enginemen can be allowed to take out an oil-burner without the presence of an inspector on the footplate. While this period is probably insufficient for them to master all the finer points of their new task, it is evident that many firemen have already become very skilled in the economical and efficient use of the fuel. Five engines of the "Castle" class have so far been equipped; two of these are allocated to Old Oak Common, two to Bath Road shed, Bristol, and one to Laira shed, Plymouth. In addition to the above "Castles," thirty-two oil-fired "Hall" and 2–8–0 freight engines are stationed at other depots throughout the system.

Through the courtesy of Mr. Hawksworth the author was privileged to make some footplate journeys under widely varying conditions of service. One could not, for example, imagine two more contrasting roads than the main line between Paddington and Bristol, and the Cornish main line from Plymouth to Penzance. In the former case the gradients are so even that a locomotive may run in almost constant conditions of steaming for half an hour or forty minutes on end, whereas in Cornwall there is a frequent alternation of extremely severe adverse gradients, and descents so sharply curved as to preclude maximum speeds much in excess of 55 m.p.h. Furthermore, the rated loads in Cornwall have been fixed high, and while these form a striking measure of locomotive capacity they demand enginemanship of the highest order. The fluctuating demands for steam thus provided an unusually interesting test of firing skill on the oil-burning engines.

LONDON TO BRISTOL

The first journey to be described was made on the fastest train to-day running between London and Bristol, the 9.5 a.m. from Paddington, allowed 2 h. 18 min. for the run of 118·3 miles. A quick comparison between the timing and that of the pre-war "Bristolian" express, 1¾ hours, would suggest that the standard of locomotive performance required is nowadays very much lower than in 1935–9. This is not so. The train loads of the present time are greater, to such an extent indeed as to outbalance the decline in overall speed. The 9.5 a.m. express of to-day makes one intermediate stop, at Reading, but it also carries a heavy slip-portion for Bath, which means that the minimum load out of Paddington is 370–375 tons, against the 250 tons of the pre-war train. The Reading stop of the present 9.5 a.m. makes direct comparison of the running difficult in the earlier stages of the journey, but the following table gives the corresponding figures for the 53·8 mile section between Didcot and Bath :—

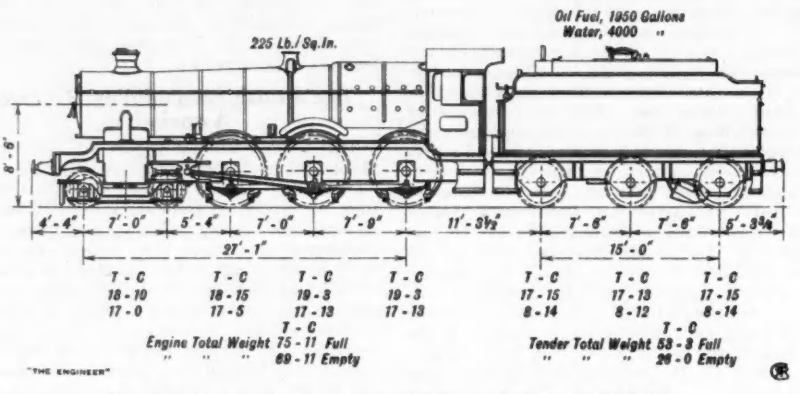


FIG. 2—DIAGRAM OF OIL-FIRED "HALL" CLASS LOCOMOTIVE

Average booked speeds	Pre-war 10 a.m.	Post-war 9.5 a.m.	
Didcot-Swindon ...	72 m.p.h.	58 m.p.h.	
Swindon-Chippenham	74·2 m.p.h.	58·8 m.p.h.	
Chippenham-Bath ...	67·4 m.p.h.	59·4 m.p.h.	
		Minimum	Normal maximum
Load, gross tons behind tender ...	255	370	445
Average d.b.h.p. Didcot-Swindon ...	921	880	1034
Estimated coal consumption in lb per square feet of grate area per hour ...	87·5	83·7	98·2

Between Didcot and Swindon, 24·2 miles, the line is rising at an average inclination of 1 in 800, and beyond Swindon the gradients are favourable. At the present time speed is subject to a general limitation over the entire main line network of the Great Western Railway to a maximum of 75 m.p.h., whereas the pre-war limit in suitably aligned stretches, such as that between Swindon and Chippenham, was 90 m.p.h. This present restriction is reflected in the moderate speeds now booked west of Swindon. The true comparative test of locomotive performance lies on the slightly adverse 24 miles west of Didcot. Here the average drawbar horsepowers needed for timekeeping have

* The first article, entitled "The L.N.E.R. 2-6-2 'Green Arrow' Class", appeared October 11, 1946; the second, entitled "The L.M.S.R. 'Coronation' Class Pacifics", appeared December 13 and 20, 1946.

been estimated and comparative figures calculated for the firing rate. For the latter the test figure for the "Castle" class engines, namely, 2·8 lb of coal per d.b.h.p.-hr., has been taken, and while this may well not give an exact estimate the comparative figures should be in the right relation. From these estimates the firing-rate on the present 9.5 a.m. would appear to be

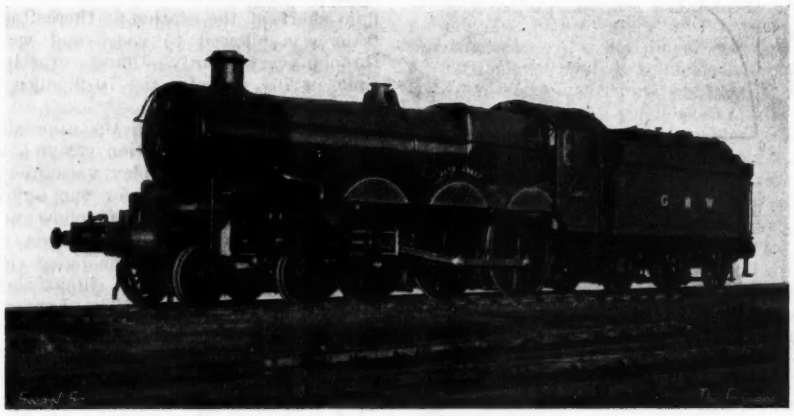


FIG. 3—OIL-FIRED "CASTLE" CLASS EXPRESS PASSENGER ENGINE

little less than that of the "Bristolian," even when the former train is carrying its minimum load; while on busier occasions, notably on Monday mornings, when the load out of Paddington is usually one of thirteen bogies, the firing rate is considerably heavier than on the pre-war train.

It is important to bear this comparison in mind while assessing the duties set to the oil-fired engines. My trip was made on a Saturday, when we had the minimum load and a comfortable margin was shown, in that a total of 6¼ min. lost by sundry signal and engineering slacks had been recovered by the time Chippenham was passed; approaching Bristol sufficient time was in hand to offset a brief stop for signals outside Temple Meads station, and still to bring in the train punctually at journey's end. From my observations, the heavier loadings can also be managed very satisfactorily by the "Castle" class engines. On a previous trip with a coal-burning engine and a load of 445 tons, the Didcot-Swindon stretch was covered at an average of 53·4 m.p.h., in spite of a loss of fully 3 min. by adverse signals; the net average speed was 60 m.p.h. These figures are quoted to show that the standard of running required and actually performed is high.

On my trip we took eleven coaches out of Paddington, 349 tons tare, and 375 tons with passengers and luggage. The engine was "No. 5039" "Rhuddlan Castle," manned by Driver A. Lisk and Fireman A. W. Brown, of Old Oak Common shed, and we were accompanied by Inspector Pullen, of Swindon. The oil-firing controls are conveniently arranged on the left-hand side of the cab. Electric light has been provided for night running and the battery box serves conveniently as a seat for the fireman whence he can keep the necessary watch on the smoking of the chimney and have all the firing controls to hand. The only occasions on which he had to leave this position were at Goring and Keynsham water troughs, in order to operate the water scoop. The morning was fine and calm, with a slight tendency to fog in the Thames Valley. Ground frost during the night had left the rails outside Paddington rather slippery, and in preference to using sand in the track

circuited area, the driver started the engine under very easy steam, which is reflected in the time of 3¾ min. taken to pass Westbourne Park, 1·3 miles. After that "No. 5039" worked into a characteristic piece of brisk "Castle" running and in steady conditions of steaming one could note the details of the oil-firing.

From Old Oak Common the cut-off was 20 per cent, and from Hayes 17 per cent. The latter adjustment was made as the speed was approaching 60 m.p.h., and thereafter an average of 64·5 m.p.h. was maintained for 13 miles of virtually level road, until a reduction of speed was required for an engineering slack. Just prior to this Maidenhead had been passed on time, 24·2 miles from Paddington in a shade under 28 min. The firing was carefully regulated to suit the driver's adjustments of the reverser, and the exhaust from the chimney was maintained at no more than a pale grey plume. The regulating wheel permits of an infinitely fine adjustment of the oil supply to the burner. The sector is divided into ninety notches. While the reverser was set for 20 per cent cut-off the pointer of the oil-feed regulator was at notch 44; this was altered to 42 when the driver linked up 17 per cent cut-off but after a while this was found to be rather too much, as the white feather began to show at the safety valves. A further reduction to "40" balanced things nicely while the engine was running at a steady speed of 65 m.p.h. The pressure of the steam supply to the oil burner was between 55 lb and 60 lb per square inch, and supply to the heating coils in the oil tank in the tender was regulated to give an oil temperature averaging about 150 deg. Fah. The actual pointer position on the sector of the oil-feed regulator should not be taken as an index of the amount of oil passing. On this particular engine there was backlash in the gears and a reading of, say, "40" did not necessarily mean that the feed was 45 per cent of full capacity.

The long slowing to 40 m.p.h. beyond Maidenhead, for permanent way work did not cause any appreciable loss of time, as the engine was accelerated very rapidly afterwards. The 35th mile post from Paddington was passed in 39½ min. and we should have reached Reading punctually but for a succession of adverse distant signals in the near approaches to the station. Actually we arrived 1 min. late — 42 min. for 36 miles — the net time being 38½ min. or an average of 56 m.p.h. from start to stop. While standing in Reading station Mr. Pullen turned off the oil supply completely for a moment, so that firebox and burner could be examined and a quick inspection made for carbon deposits. This is a normal procedure when there is any reason to suspect the presence of an accumulation of carbon deposit in the firebox. The inspection is made through the small port in the fire-door which is normally covered by a small glazed window. On this occasion we saw that the firebox was perfectly clean, with no trace of incrustation. In regular working the fire-door of an oil-burning engine may not be opened while the engine is in steam. So far the oil consumption as read from the gauge on the tender was 120 gallons, 3·3 to the mile, against a water consumption of about 1000 gallons.

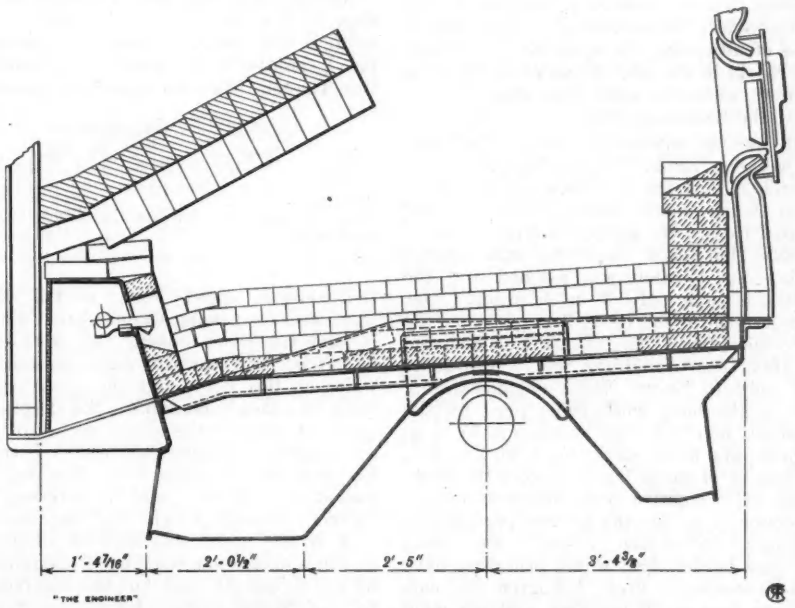


FIG. 4—FIREBOX ARRANGEMENT OF OIL-FIRED "CASTLE" CLASS 4-6-0 LOCOMOTIVE

With a dry rail and generally good conditions, the restart from Reading was very brisk. The diagram, Fig. 5, gives particulars of the acceleration in conjunction with the cut-offs used. This running was typical of the "Castle" class engines and once

again the oil feed was regulated so as to keep that grey plume flowing from the chimney, and boiler pressure just below blowing-off point. The driver was getting a little time in hand to offset the effects of a heavy slack for relaying that was in operation immediately to the east of Steventon station. Thus we passed Didcot 2¼ min. ahead of time, in 18¾ min. from Reading, 17·1 miles. Recovery was again rapid, with speed rising from 15 to 50 m.p.h. in 2¼ miles, but soon after we began to meet with a running handicap which I had been half expecting since we passed Didcot in such good time. In front of us was the 8.55 a.m. express from Paddington to South Wales. This train also had called at Reading, and although booked non-stop from there to Newport with similar intermediate timings it was conveying a considerably heavier load than our train and one could not expect the recovery from permanent way slacks to be so rapid as in our case.

We had regained speed so well from Steventon as to pass Wantage Road in 39 min. from Reading, 34·4 miles, and speed was just coming up to 60 m.p.h. once more, despite the now definitely rising character of the road, when we sighted adverse signals at Challow. Visibility was very good and the "caution" aspect of the distant signal had been observed some time before we came to the A.T.C. ramp and the siren started up. The fireman, working in close synchronisation with the driver's adjustments, lessened the volume of oil feed. After we had passed the distant signal while the driver was slowing the train down and scanning the road ahead, the high footplate of the "Castle" engine permitted of a backward view of the signal for a short time and a few seconds after we had passed it was pulled to the "clear." Speed had by that time been reduced to 45 m.p.h., and it was evident that we were very close on the tail of the South Wales express. It was thus a case of adjusting our speed to avoid signal checks in the next 20 miles to Wootton Bassett, where the other train would diverge on to the Badminton line.

It was an interesting and skilful piece of working, for in the later stages of this stretch of line the two trains cannot have been much more than 2 miles apart. Three times we sighted adverse distant signals, but each time the arm cleared before the location was reached and the reduction was only 3 or 4 m.p.h. Our own average speed of 58·3 m.p.h. over the 13·5 miles from Uffington through Swindon to Hay Lane signal-box was a testimony not only to Driver Lisk's enginemanship, but to the hard work being done by the Landore men on the 14-coach 8.55 a.m. express, and to the smart block working in a succession of signal-boxes. From the viewpoint of locomotive performance it meant, of course, that for the greater part of this distance "Rhuddlan Castle" was being steamed harder than would otherwise have been necessary. From Uffington the cut-off was kept at 20 per cent, and the main valve of the regulator was used, apart from the brief times when steam was shut off after adverse signals had been sighted in the distance. Despite this hindrance, Swindon was passed less than a minute late, in 46¾ min. for the 41·3 miles from Reading.

The worst check from the preceding train came just as she was about to take the diverging road at Wootton Bassett. A speed restriction is enforced for trains taking the Badminton line and the slower running through the last block section reacted upon us, and we were checked to 40 m.p.h. at Studley signal-box. But once through Wootton Bassett all was plain sailing. The reverser was wound back to 16 per cent cut-off and the regulator eased, while still keeping the main valve in operation. Rapid acceleration down the 1½ mile incline at 1 in 100 brought speed up to 76 m.p.h.

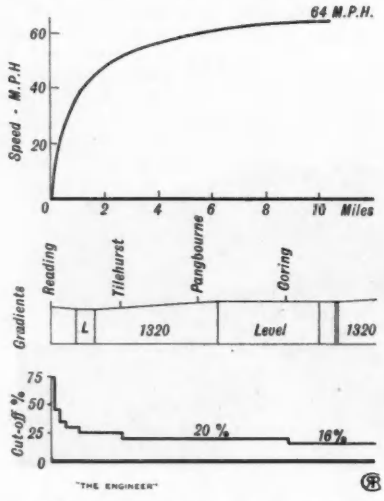


FIG. 5—WORKING OF "CASTLE CLASS" ENGINE "NO. 5039" STARTING FROM READING

at Dauntsey, and on the very slight fall that follows to the crossing of the River Avon, on a gradient of 1 in 660, speed was held steadily at 75 m.p.h. Although the engine was then being easily steamed, the higher speed called for an oil-feed practically equal to that used between Southall and Maidenhead, and from the foot of the Dauntsey incline the pointer of the oil-feed regulator was set at "41."

At the 91st mile post, adjacent to the river bridge, the gradient changes to a rise at 1 in 660, which continues unbrokenly for 8 miles to the eastern entrance of Box Tunnel. With no immediate change in the controls, speed began to fall off at once, and on passing Chippenham, 3 miles beyond the river crossing, we were doing 64 m.p.h. The regulator was opened a little wider at this point and the speed settled down to a steady 60 m.p.h. But despite the check at Studley the slight arrears of time on passing Swindon had been recovered; Chippenham, 58 miles from Reading, was passed in 62¾ min., and on entering Box Tunnel, through which the line descends at 1 in 100, steam was shut off altogether. In the tunnel, while coasting, a maximum of 68 m.p.h. was attained, but this was reduced by the brakes, before taking the reverse curve through Box station. We were comfortably on time, and with the train coasting freely there was no need to put on steam again before coming to Bath.

From Box station, down the beautiful winding valley of the By-brook the gradient is no steeper than 1 in 850; but a stretch of 4 miles was covered without steam in 4½ min. A slip portion of three coaches was to be detached at Bath, and here the operation is made more tricky by the existence of the 30 m.p.h. speed restriction through Bath station. So that the vacuum reservoirs on the leading slip coach may be fully charged and the slip guard assured thereby of ample brake power, it is essential to have not less than 23in of vacuum in the train pipe at the moment of slipping. The reduction of speed for observance of the 30 m.p.h. restriction must therefore be made well before the station so that the brakes can be fully released throughout the train in good time. Actually Driver Lisk made one gentle brake application about a mile short of the station; thereafter the train was allowed to coast and we ran through very gently—almost exactly on time, in 76¼ min. for the 70·9 miles from Reading.

I must confess that in the approach to Bath I found my attention straying more than once from the duplex vacuum gauge and the speedometer; for the approach to the city on this morning of mellow autumn sunshine was lovely beyond words. The grouping of the hills, the changing colours in the trees, and then as a climax the sixteenth century abbey, "The Lantern of England," set among the gardens, the terraces and church spires—well, we must be on to Bristol!

The allowance of 16 min. for the last 11·4 miles of the journey, on slightly falling gradients throughout, leaves an ample margin of time for the usual careful approach to Bristol, with a speed restriction to 10 m.p.h. over the last half-mile. With a reduced load of 275 tons a speed of 67 m.p.h. was quickly attained, and Keynsham, 77·7 miles passed in 83½ min. from Reading. With cautious running and one brief stop for signals the last 4½ miles took nearly 9 min., but our arrival was almost exactly on time. A few figures relating to this run may be mentioned at once, though the general performance assumes a greater interest when compared to that of the other oil-fired "Castle" engine working on the Cornish road. The table below gives the approximate consumption of water and oil on the different sections of the run.

Section	Miles	Oil consumed, gallons	Oil per mile	Water consumed, gallons	Water per mile, gallons
Paddington-Reading	36	120	3·3	1000	28
Reading-Bath	70·9	200	2·8	2350	33
Bath-Bristol	11·4	20	1·8	250	22

The water consumption throughout the trip, of 3600 gallons, or, roughly, 30 gallons per mile, was in the usual "Castle" tradition, while it will be seen that the total oil consumption of 340 gallons indicated an evaporation of roughly 10½ gallons of water per gallon of oil. The steaming of the engine was consistently good throughout, and pressure maintained invariably between 220 lb and 225 lb per square inch.

(To be continued)

EUROPEAN ROAD TRANSPORT.—The United Nations, through the Economic Commission for Europe, recently appointed a working party to investigate matters relating to road transport. The working party held a three-day session at Geneva early in January, attended by experts from six nations, and amongst the suggestions put forward was that the improvement of the road system in Europe would provide a great stimulus to road transport. It was felt that progress towards the unification of characteristics of roads would do much, both nationally and internationally, to encourage the use of road transport and it was urged that this particular problem should be studied especially with a view to developing new highways and reconstructing existing ones.

The Gas Turbine as Applied to Marine Propulsion*

By T. A. CROWE, M.Sc., M.I.Mech.E.†

No. II—(*Continued from page 109, January 30th*)

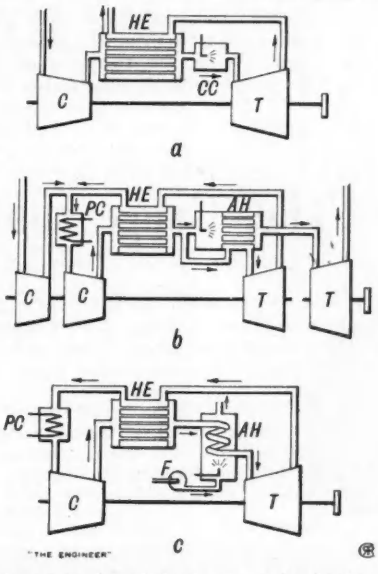
IN addition to the open cycle already considered, there are two other constant-pressure gas-turbine cycles which are being developed, namely, the semi-closed cycle and the closed cycle, which are shown in their simplest form in Fig. 7, together with the open cycle, fitted with a heat exchanger for comparison.

(a) *The Semi-Closed Cycle.*—In the semi-closed cycle (Fig. 7*b*) which has been developed by Sulzer Brothers, the compressed air, after being preheated in the heat exchanger, divides into two parts. One part passes to the combustion chamber and is used for the combustion of the fuel oil. The other part of the compressed air passes through an air heater consisting of numerous tubes which are heated by the gases from the combustion chamber. In this way the combustion gases are cooled to about 1200 deg. Fah. before passing to the power turbine, where they expanded down to atmospheric pressure and are discharged to atmosphere. The other part of the compressed air, in flowing over the air heater tubes, is also raised to the same temperature of 1200 deg. Fah. This air does not become polluted with combustion gases, and it is expanded in a turbine down to a medium pressure and is then passed through the heat exchanger. Finally, it is cooled off to a low temperature in a water-cooled precooler, and then enters the second compressor, thus completing the closed part of the cycle. The first compressor draws in from the atmosphere sufficient air to balance the quantity being used for combustion and being discharged through the power turbine.

(b) *The Closed Cycle.*—The closed cycle, Fig. 7*c*, has been developed by Escher Wyss, and is known as the "A-K Plant," after Professor J. Ackeret, of the Swiss Institute of Technology and Dr. C. Keller, of Escher Wyss, who have been responsible for its development.

In this cycle the compressed air, after passing through the heat exchanger, is heated *indirectly* in the air heater, which is in principle similar to the superheater of a steam boiler. The air remains completely free from combustion gas impurities, and the turbines and heat exchanger will therefore remain clean and free from corrosion for an indefinite period. After the air has left the turbine and passed through the heat exchanger, it is cooled to a low temperature in a water-cooled precooler before entering the compressors, which return it again through the heat exchanger to the air heater. The closed cycle is thus completely sealed off from the atmosphere and, while the plant is running at a steady load, only a small quantity of air has to be pumped in to make up for leakage losses. This make-up air is well filtered, so that no dust or salt particles can enter the circuit to harm the blades of the compressors or turbines. In normal operation the closed cycle is supercharged so that even on the low-pressure side the pressure is several times that of the atmosphere, with the result that the compressors and turbines are surprisingly small for a given output, being in this respect comparable to back-pressure steam turbines. For this reason the closed-cycle gas turbine is particularly suited to installations of large power, and outputs of 100,000 h.p. may be obtained on a single shaft, while the centrifugal stresses in the turbine blades are, on account of the comparatively small rotors, kept down to a permissible figure.

This plant might more correctly be called a hot-air turbine, and is analogous to an ordinary steam turbine with pure air taking the place of the circulating steam and water. The air heater corresponds to the boiler and superheater; the precooler corresponds to the condenser, and the compressor represents the feed pump. There are two principal differences in this analogy. First, in a steam plant the steam condenses to water after passing through the turbines and may therefore be raised to the boiler pressure by a comparatively small feed pump, whereas



a, Open cycle; *b*, semi-closed cycle; *c*, closed cycle. AH, air heater; C, compressor; CC, combustion chamber; F, combustion air fan; HE, heat exchanger; PC, precooler; T, turbine.

FIG. 7—CONSTANT-PRESSURE GAS-TURBINE CYCLES

in the air cycle the air must be compressed in the gaseous state, and therefore requires a very great deal of power to compress it and return it to the air heater. Secondly, the high temperatures which lead to high efficiencies may be used in the closed-cycle gas turbine without being accompanied by excessive pressures, as in a steam plant. High superheat temperatures may also be used, of course, in steam plants, but the resulting increase of efficiency is not particularly great, since most of the heat is still taken into the circuit as latent heat of evaporation at a comparatively low temperature.

These three types of gas turbine are all suitable for marine propulsion, and there are basic similarities. All three operate on the same basic constant-pressure cycle, and with each the efficiency may be increased by enlarging the heat exchanger, by incorporating intercoolers between the stages of compression, and by reheating between the stages of expansion.

The greatest interest, however, lies in their differences, particularly in the method of heating the working air, in the design of the heat exchangers, in the control of output, and in various other practical matters.

Air Heaters.—In the open cycle, the air is heated merely by burning fuel in it—an ideally simple way, involving the use of a comparatively small and light combustion chamber, in which the rate of heat release may be over 1,000,000 B.Th.U. per cubic foot per hour in marine plants. This simplicity is, however, accompanied by the disadvantage that the combustion gases pass through the turbine and heat exchanger, and may form deposits which reduce the efficiency of the turbine, and the heat transfer rate in the exchanger, particularly with the cheaper quality of fuels, such as boiler oil. These items of the plant would therefore have to be periodically cleaned. The compressors would also require periodic cleaning and overhaul, though no doubt less frequently than the turbine, on account of the dust or salt which may adhere to the blades or erode them and so alter their exact profile. Tests on axial compressors have shown a reduction of 1½ per cent in efficiency after running for twelve hours on air drawn from a heavy engineering workshop.

In the semi-closed cycle the air heater adds to the size and weight of the plant, and so does the precooler installed in the closed part of the cycle. The air heater, however, is comparatively small even in plants of large output for three reasons. The pressures on both sides of the tubes are very high, and therefore heat transfer rates are high. Due to the pressures inside and outside the tubes being approximately equal, the stresses are low, and the tube temperatures may therefore be very high, so that the heat transfer rates are further increased. Thirdly, only a part of the heat in the fuel has to be transmitted through the tube walls, since a considerable portion remains in the combustion gases which pass to the power turbine. The power turbine operates on combustion gases, and will therefore require periodic cleaning as in the open cycle, but the turbine which drives the compressors operates on pure air, and the heat exchanger is also free from combustion gases.

Heating the air indirectly in the closed cycle involves the use of a comparatively heavy and bulky air heater, incorporating small diameter tubes heated to a temperature somewhat above the maximum temperature of the working air. It is interesting to note, however, that, owing to the fact that the heat transfer coefficient of air varies almost directly with pressure and velocity, the tube wall temperature is kept down to within 100 deg. Fah. of the final air temperature, owing to the excellent heat transfer between the tube and the air inside it. The tube stresses are of the order of 1 to 2 tons per square inch.

Since only pure air, unpolluted by combustion gases, passes through the turbine and heat exchanger, there is no possibility of these becoming fouled or corroded. The only parts subjected to the action of the combustion gases are the outsides of the air heater tubes. In addition, since the compressors are not constantly drawing in fresh air from the atmosphere, they will maintain their efficiencies for an indefinite period.

Types of Heat Exchanger.—The size and details of the heat exchanger differ in the various cycles. The tubular contra-flow

* Institution of Mechanical Engineers. January 23rd. Twentieth Thomas Lowe Gray Lecture. Abstract.

† Engineering Director, John Brown and Co., Ltd., Clydebank.

type is the one most favoured on account of its simplicity and reliability, although considerable development work is being carried out on the rotating regenerative type. This latter would be smaller and lighter for a given duty, but the difficulty of obtaining effective sealing around the rotor between the high and low-pressure sides has so far prevented its adoption in practice.

FIG. 8—HEAT EXCHANGER OF SULZER 7000-9000 S.H.P. GAS TURBINE

In the open cycle the heat exchanger is built up of tubes which cannot be smaller than about $\frac{3}{4}$in in bore, on account of the possibility of their becoming choked by deposits from the combustion gases, and so requiring to be cleaned internally.

In the semi-closed cycle the heat exchanger operates with pure air on both sides of the tubes, so that small-bore tubes may be used without any fear of their becoming choked. The nest of tubes for the Sulzer 7000-9000 s.h.p. plant is shown in Fig. 8. The use of such small-bore tubes gives a very large surface area for a given cubic capacity of heat exchanger, and since the air, even on the low-pressure side, is considerably above atmospheric pressure, the heat transfer rates are comparatively high. The compressed air cannot, however, be preheated to a temperature approaching that of the hot air exhausting from the turbine into the heat exchanger, since the quantity of exhaust air is about 40 per cent less than the quantity of compressed air being preheated on its way to the air heater.

In the closed cycle the tubes are also very small, and may be as fine as $\frac{1}{4}$in in bore, since both inside and outside the tubes there is again only pure air. In addition, the air pressures are normally about six or seven times those in the open cycle, with a corresponding improvement in the heat transfer rates—a point which has already been illustrated in Fig. 4. As a result of these excellent characteristics it is possible to obtain a heat exchanger effectiveness of over 90 per cent in commercial installations, and it is this fact that is largely responsible for the high overall efficiencies obtained with the closed cycle.

Power Control.—The method of controlling the power output differs in the various types of gas turbines. In the open cycle the power is controlled by varying the quantity of fuel supplied to the combustion chamber, and thereby varying the turbine inlet temperature. At the same time it is best to reduce the speed of the machines in order that the altered flow conditions in them should be partially corrected. In a marine plant, the speed of the power turbine falls off as the speed of the propeller is reduced, at part loads, and in a two-shaft arrangement the speed of the high-pressure turbine and compressors may be suitably adjusted, but even so, there is a serious loss of efficiency at part loads, owing to the reduced turbine inlet temperature.

The output of the semi-closed cycle gas turbine is adjusted by varying the pressures in the circuit while the temperature at the turbine inlets remains practically unchanged; this is carried out by altering the speed of the high-pressure turbine, and hence the speed of the compressors. The pressure ratios and mass flows vary with the change of speed, but the velocity ratios in the blading remain much the same. It is interesting to note, however, that in marine plants the law applying to the variation of propeller speed with a change of power is exactly the same as that which ensures the maximum efficiency of the useful output turbine. As a result, the efficiency of the whole plant only falls off very slightly at part loads.

The output of the closed cycle is very simply increased by introducing more air into the working circuit, either from a compressed air reservoir, or by means of a small reciprocating or rotary compressor. As a result, the pressures and densities of the air throughout the circuit rise, with a proportional increase in power. The supply of fuel to the air heater must, of course, be increased; otherwise the turbine inlet temperature will fall. However, the heat capacity of the tubes in the air heater is sufficient to prevent any sudden change of temperature occurring. In a similar manner the output is decreased by releasing air from the working circuit. The pressure ratios and temperatures throughout the circuit remain the same at all powers, so that, provided the turbines and compressors are kept running at a constant speed, the velocity ratios will not alter, and therefore a high efficiency will be maintained at all loads.

(To be continued)

The Gauge and Tool Exhibition

No. II—*(Continued from page 111, January 30th)*

WE continue below our description of some of the equipment shown at the Gauge and Tool Exhibition, which closes today, February 6th.

BIRMINGHAM TOOL AND GAUGE COMPANY, LTD.

Together with a variety of standard tools the Birmingham Tool and Gauge Company, Ltd., Soho Hill, Handsworth, Birmingham, is showing a large number of special cutters, form tools, form-relieved milling cutters, multi-diameter boring tools, &c.

JEWEL SETTING PRESS—BIRMINGHAM TOOL AND GAUGE

A recent product of this firm is a small precision jewel setting press designed for use in the manufacture of watches, clocks and meters. The machines are made in two types, for hand and for foot operation, the foot-operated press being shown in the accompanying illustration.

This press has a hardened steel ram which slides in two steel bushes pressed into a rigid cast Meehanite body. The ram is keyed to stop rotation and on its lower end is a stop which also provides a bearing for the end of the inside pressure pin. This pin passes right through the ram and at its top there is a micrometer through which fine adjustment of its length of projection can be made. Once set the pressure pin is locked in position in the ram by means of a knurled screw. The pressure pin setting micrometer barrel is graduated in intervals of 0·0005in.

MOORE AND WRIGHT (SHEFFIELD), LTD.

Included in the wide range of engineers' hand and precision tools made by Moore and Wright (Sheffield), Ltd., 127, Trafalgar Street, Sheffield, 1, is an interesting Braille bevel protractor specially designed for use by blind technicians.

This protractor is similar to the ordinary universal bevel protractor in that it consists of a blade attached to a rotating drum pivoted in the centre of a circular base plate having an outward extension. The desired angle, or the angle being measured, is that between the blade and the extension of the base plate.

Immediately over the lower rotating drum on the base plate are two more drums.

The upper of these drums is divided into thirty-six divisions, each equal to a $\frac{1}{4}$ deg., and is marked at every four divisions, i.e., at every whole degree. One complete revolution of the drum indicates 9 deg. The divisions are indicated by raised teeth which can be easily discerned by touch, and the degree markings are in Braille characters. The zero line can be distinguished from the ordinary divisions in that it goes right across the drum. Thus, by reference to the raised line on the centre drum, which remains stationary and

does not revolve, it is possible to say by how many degrees or ½ deg. the upper drum is turned.

The lower drum, which is capable of revolution and is actuated by the upper drum, is divided into forty raised tooth divisions, each equal to 9 deg. Thus, one complete revolution of the upper drum moves the lower drum one-fortieth, or one division, equal to 9 deg. In other words, the lower drum acts as a counter of the revolutions of the upper drum. The marking in Braille on the lower drum is at every five divisions, and is as follows : 0, 45, 90, 45, 0, 45, 90, 45. The first zero is indicated by the raised tooth being carried right across the drum. The other divisions and the centre zero are simply raised teeth.

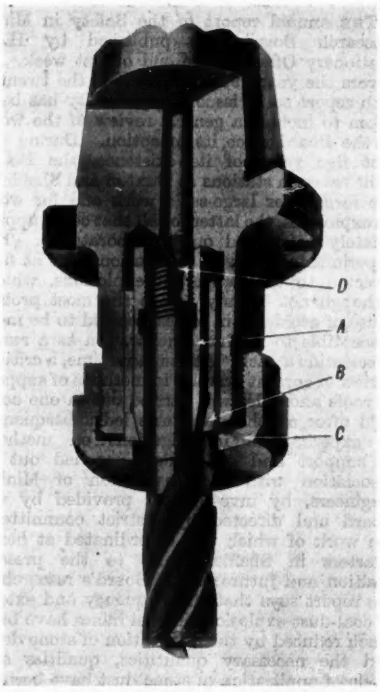
When the protractor is closed and the blade and the extension of the base plate are in line the reading is zero, and the three zero lines on the drums are all in line.

Any opening of the protractor causes displacement of the upper and lower zeros with respect to the fixed centre zero. To read the protractor the displacement of the movable zeros with respect to the fixed centre one is ascertained by touch. It is possible to feel how many degrees or ½ deg. have moved on the upper drum up to 9 deg., and to feel on the lower drum how many groups of 9 deg. have been moved.

Clarkson (Engineers), Ltd.

A wide selection of cutters and end mills to be seen upon the stand taken by Clarkson (Engineers), Ltd., of Nuneaton, includes the recently introduced $\frac{1}{16}$in and $\frac{1}{32}$in diameter end mills and slot drills of the two-flute type, which are now being made by the firm. Of considerable interest is the "Autolock" self-locking chuck which the firm makes in two sizes to hold cutters of from $\frac{1}{16}$in to 1½in.

These chucks are designed for use only with special cutters, which have the upper ends of their shanks threaded. They incorporate



Self Locking Chuck—Clarkson

means by which any tendency a cutter may have to slip under working load reacts to increase the grip of the chuck on the shank of the tool. As can be seen from the photograph we reproduce, the design and principle upon which the chuck is designed is quite simple and yet effective.

The shank of the tool is freely screwed into a collet A over which is slid a sleeve B, the tapered end of the collet registering in a corresponding tapered section at the end of the sleeve. This assembly is inserted into the body of the chuck and firmly held in position by a knurled ring C. As the knurled ring is tightened by hand it forces the upper end of the tool into firm contact with a centre D in the body of the chuck. It will be appreciated that as working load is applied to the cutter its tendency to turn in the chuck reacts on the screwed portion of the collet. The collet is thereby forced downwards and the taper on its nose end is pressed deeper into the corresponding taper in the sleeve, which is prevented from downwards movement by the nose ring. The closing effect on the tapered nose of the collet tightens its grip on the tool shank.

A. C. Wickman, Ltd.

The many and varied uses of tungsten carbide as a wear-resisting material in tools, gauging equipment, &c., is shown in the display of its products which has been arranged by A. C. Wickman, Ltd., of Coventry.

The Cornelius electronic comparator to be seen upon this stand is adaptable for a very wide range of non-destructive industrial testing and inspecting work. The six sets of equipment being demonstrated are of the same basic design, but each is used to demonstrate a different field of application. According to the manufacturers the theory of electronic inspection and comparison of materialsis based on the principle that the structural formation of all substances is always basically the same ; that each similar atom and molecule in a substance must respond to a definite electronic disturbance in the same way according to its structural value. For this reason, two identical test pieces placed in the electronic field of an instrument will modulate the frequency in that field in the same way and produce identical indications in the instrument meter. This feature can be used to compare a series of test pieces with a standard test piece of known value, any variation caused by a defect or divergence from the standard being indicated in the meter reading.

The six applications for which Cornelius comparators have been adapted for the purposes of the exhibition are as follows :—Material and component inspection for chemical composition, hardness, and for cracks and flaws of all types on or below the surface ; dimensional comparison with micro-inch sensitivity ; plating and coating inspection ; surface finish comparison ; stress-strain analysis ; and hardness testing.

The photograph we reproduce shows the instrument being used as a bench comparator having variable full-scale deflection tolerances from 0·001in to 0·000025in in six steps.

Weir Precision Engineering, Ltd.

The tools and fixtures exhibited by the Weir Precision Engineering, Ltd., of Southampton, include the small shoulder distance-measuring gauge shown in the illustration. This gauge is particularly designed to permit rapid and accurate checking of the shoulder lengths on small parts produced in large quantities such as on automatics.

The gauge has a substantial base, on the centre column of which are fixed interchangeable adaptor plates. Each adaptor plate has a hole in its centre through which the lower part of the component freely passes until its shoulder registers on the top surface of the plate. A lever mechanism below the adaptor plate is connected to the spindle of a dial indicator set on an inclined column at the rear of the base.

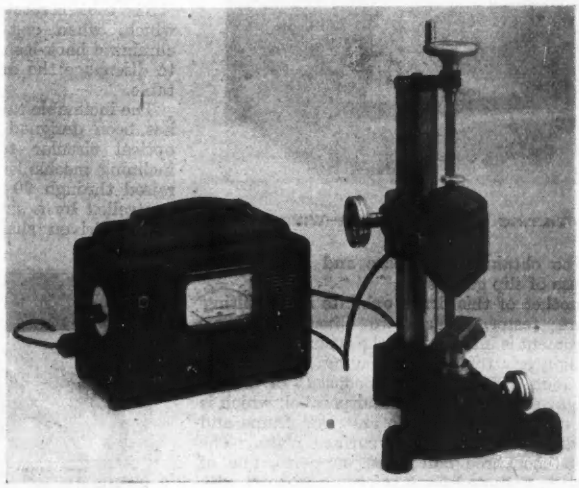
The lower ends of the components protruding through the adaptor plate actuate the indicator, through the lever mechanism, to give a com

Shoulder Gauge—Weir

parative reading as to the shoulder distance on the dial. The indicator dial is set by means of a master shoulder gauge made to correspond with the adaptor plate used with the component.

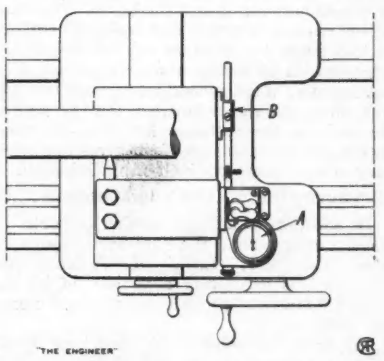
J. E. Baty and Co., Ltd.

Amongst the instruments displayed upon the stand of J. E. Baty and Co., Ltd., 39, Victoria Street, London, S.W.1, is a useful little attachment for lathes and other machine tools. It is designed to provide visual and direct



Cornelius Electronic Comparator—Wickham

dimensional control in machining operations. This indicator is intended to supplement any indistinct scales and verniers on the hand wheels



Machine Tool Indicator—Baty

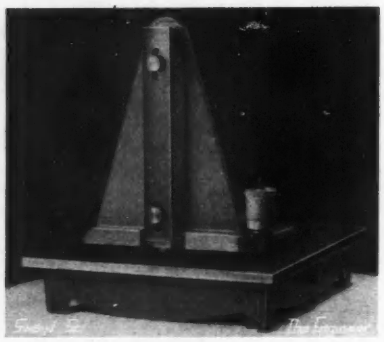
controlling machine tool slides, and avoid the doubtful accuracy of worn lead screws.

We reproduce a diagram showing the indicator

as applied to the cross slide of a lathe. The dial indicator A is enclosed in a housing, with a transparent protective cover, which is attached to the saddle. A friction sleeve B is fixed to the side of the cross slide and a rod passing through it is linked with the dial indicator spindle. This rod is held by friction pads in the sleeve and any movement of the slide, and thus the tool in respect to the work, is recorded on the indicator dial. The indicator gives direct readings of reduction of work diameter in thousandths of an inch. When commencing work the first cut is made and the diameter of the work is measured. The indicator is then set either to zero, or to a dimension from which its hand will turn to zero at the tool setting for the finished machining size. When the spindle of the dial indicator has travelled its normal ¼in range, the operating rod can be pressed back through the friction sleeve to its original position, and readings over a further ¼in range can be made.

WINDLEY BROTHERS, LTD.

For the purpose of machining magnetic materials at any required angle—single or compound—an electromagnetic sine table has been developed by Windley Brothers, Ltd., Crown Works, Chelmsford. This instrument consists of a magnetic chuck mounted on a sine table. One end of the chuck is mounted on trunnions on the sine table, and it forms a second sine table with which compound angles



TILTING SQUARE TESTER—WINDLEY

can be obtained with ease and accuracy by the use of slip gauges.

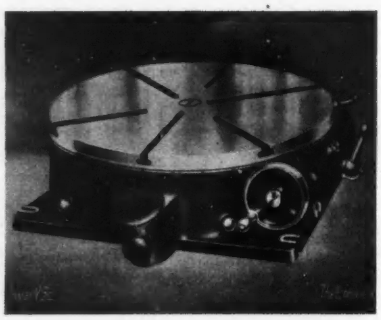
Another of this firm's exhibits is the tilting square tester, which we illustrate. This instrument is intended for the accurate checking of engineer's try squares having blades up to 12in long. The apparatus consists of a steel straight-edge, lapped flat and parallel, which is held upright in a tiltable cast iron frame and mounted on an accurate surface plate. The frame has three ball point supports, one of which is actuated by a micrometer head with a 2in barrel and reading to one ten thousandth of an inch.

When being tested a square is placed on the table with its blades against the straight-edge. The straight-edge is tilted by means of the micrometer screw until a light-tight fit is obtained between it and the blade. The micrometer reading is taken and then the square is moved round to the other side of the straight-edge, which is again trued by means of the micrometer, and a second reading taken. One-half of the difference between the two readings divided by the distance between the micrometer axis and the axis of tilt gives the inaccuracy of the square per inch of blade length.

COVENTRY GAUGE AND TOOL COMPANY, LTD.

In addition to a large number of tools, jigs, hobs, cutters, &c., the Coventry Gauge and Tool Company, Ltd., of Fletchamstead, Coventry, is exhibiting a variety of its well-known "Matrix" precision gauges and measuring instruments.

The firm is showing for the first time the new Watts-Coventry Gauge optical circular table. This table has been designed particularly for high precision work on such machines as jig borers, and with it the table movement is clearly shown on a 3in diameter projection screen at the front. This screen incorporates a separate image which is used for setting purposes. There are three apertures on the screen, in the top one are shown the main circle divisions graduated at ten-minute intervals and numbered every degree. In the centre



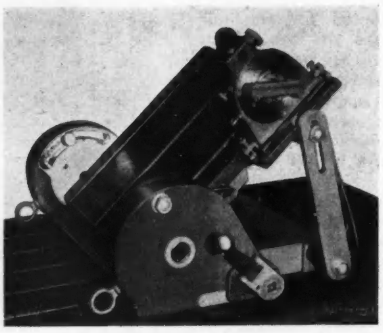
OPTICAL CIRCULAR TABLE—COVENTRY GAUGE

aperture the same divisions are projected under double magnification for accurate setting purposes. A micrometer scale imaged in the lowest aperture covers one ten-minute division on the main circle and breaks it down in 200 parts to give direct reading to three seconds. This optical micrometer is controlled by means of a milled head set in a recess just below the screen.

The projection system is built into the body of the table and is a completely sealed unit from which dust and oil and heat from the lamp are excluded. Illumination is supplied from an external lamp, housed to avoid the effects of temperature, the light entering the system through a window of heat-resisting glass.

The table is rotated by an endless worm drive which, when engaged, is spring loaded to eliminate back-lash; a release cam is operated to disengage the drive for free rotation of the table.

The inclinable table, which is also illustrated, has been designed specially for use with the optical circular table. This table has an inclining mechanism through which it can be raised through 90 deg. The raising action is controlled by a single lever which operates a ratchet-driven shaft running across the full



INCLINABLE TABLE—COVENTRY GAUGE

width of the base. Worm wheels mounted at either end of the shaft provide equal support at the extreme sides of the table when it is inclined. A platform is provided at one corner of the table to carry a microptic precision clinometer through which inclination of the table to within three seconds can be controlled.

REDMAN TOOLS AND PRODUCTS, LTD.

In order to simplify piercing and cropping tooling lay-outs and reduce tooling costs for presses, Redman Tools and Products, Ltd., Progress Way, Croydon, Surrey, has developed two standard units, known as the "Unipierce" and the "Unicrop."

The "Unipierce" has a heavy rigid cast body with a throat 6in deep. Its anvil contains a removeable hardened steel die, and suspended from the overarm above is a corresponding punch assembly in which the punch is retained in its uppermost position by a light coil spring. Punches and their complementary dies up to ¾in dia. can be used in these units, and when fitted with the largest diameter punch. the tool is capable of piercing holes through ½in mild steel plate. A range of standard diameter tools is stocked by the makers for use with these units, and we understand that special punches are available for piercing square, oval or rectangular holes. A stripper bush actuated by a heavy coil spring is incorporated in the punch assembly.

The units can be used individually, or a series of units containing punches of appropriate sizes can be bolted at the required positions in relation to a component on a base plate or press bolster. With such an assembly the punches, which are not in any way attached to the ram of the press, are actuated by a blow-plate bolted to the top ram. In order to facilitate the setting up of the units a ¼in diameter pilot hole is provided in the body below the anvil, and this hole is on the centre line of the punch and the die. One means of setting a series of units is by use of a template with ¼in diameter holes drilled at the appropriate punching positions. Pins set in these holes can then be used to locate the piercing units correctly on a base plate prior to their being clamped in position.

For other applications the dies and punches are supplied as individual units without the holder body, and in this form they can be clamped on plates to form a complete set of piercing tools in an adjustable or semi-permanent tool.

The "Unicrop" works on a similar principle to the piercing tool, and it is designed to permit right-angled cropping of up to 2½in by 2½in in mild steel plate up to ¼in thick. Two adjustable stops in the body of the unit enable the setting to be arranged for either cropping or notching, and irregular shapes can be cropped by altering the shape of the punch and dies.

The Safety in Mines Research Board

THE annual report of the Safety in Mines Research Board was published by H.M. Stationery Office at the end of last week. It covers the year 1946, and as it is the twenty-fifth report to be issued, opportunity has been taken to include a general review of the work of the Board since its inception. During the first five years of its existence, the Board built research stations at Buxton and Sheffield, the former for large-scale work and for work on explosives, the latter for all that could appropriately be carried out in laboratories. The experimental work of the stations was at first directed to the danger of explosions, which, although not by any means the most prolific cause of accidents in mines, seemed to be most susceptible to further amelioration as a result of scientific attack. At the same time, a critical review of current practice in methods of support of roofs and sides was carried out in one coal-field after another, and this led subsequently to experimental investigations on methods of support and on haulage, carried out in association with the Institution of Mining Engineers, by investigators provided by the Board and directed by district committees, the work of which was co-ordinated at head-quarters in Sheffield. As to the present position and future of the Board's researches, the report says that the frequency and extent of coal-dust explosions in coal mines have been much reduced by the application of stone dust, and the necessary quantities, qualities and mode of application of stone dust have become better defined as a result of research. There remain, however, many outstanding questions to be investigated. Firedamp explosions are another subject for the Board's continued researches and the revision of methods of haulage now being forcibly advocated is yet another matter which presents problems for investigation. The progress made in the work of the Board during the year reviewed is set out in five separate sections of the report, dealing with coal-dust explosions, electrical researches, mining explosives and shotfiring, roof control and supports and examination of winding and haulage gear.

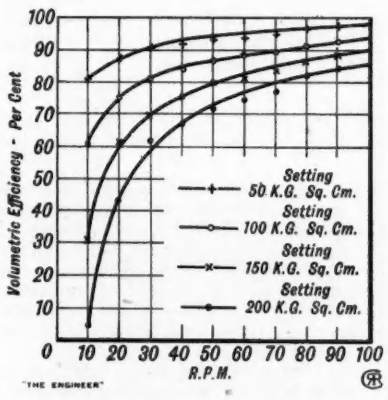
Petrol Injection Equipment Development*

By K. BROOK, A.M.I.Mech.E.,† and W. E. W. NICOLLS, B.Sc.‡

Possible Advantages of Petrol Injection

Improved Volumetric Efficiency.—The biggest single improvement likely to result from the application of the injection system to unsupercharged automotive engines is the additional torque resulting from improvement of volumetric efficiency, owing to the removal of the carburettor choke, freedom in manifold design, and the elimination of induction heating. While this gain occurs chiefly at higher speeds, where its value under road conditions may be debatable, in a particular engine of which the authors have knowledge improvement was also effected at lower speeds amounting to an increase of brake mean effective pressure from 128 lb to 136 lb per square inch at 800 r.p.m.—or some 6·25 per cent. The corresponding increase at the maximum speed of 2500 r.p.m. was 9 per cent from 125 lb to 136 lb per square inch. This general raising of the torque curve was achieved without sacrifice of fuel economy. On an engine for which carburettor figures are not available a maximum brake mean effective pressure of 146 lb per square inch was obtained at 800 r.p.m., and 141 lb per square inch at the maximum speed of 1800 r.p.m.

Distribution.—By the use of an individual metering pump to each cylinder close equalisation of fuel charges to all cylinders is obtainable. To be of value, this accuracy of fuel distribution must be accompanied by equal accuracy of air distribution, but this should not be difficult to achieve in view of the greater freedom permissible in manifold design. In multi-cylinder engines this simplification of the distribution problem allows a lowering of the mean mixture strength, giving better economy, more even sharing of load, equalisation of cylinder, piston and valve temperatures, and a general improvement in the smoothness of running, particularly at low speeds. This close distribution obtained by the injection system


Volumetric Efficiency - Per Cent
R.P.M.
Setting 50 K.G. Sq. Cm.
Setting 100 K.G. Sq. Cm.
Setting 150 K.G. Sq. Cm.
Setting 200 K.G. Sq. Cm.
THE ENGINEER

Effect of varying nozzle opening pressure

Fig. 1—*Slow-Speed Delivery Characteristics*

will have added advantage if future fuels have a high degree of lead content.

Fuel-Air Ratio.—The optimum mixture strength requirements of petrol engines vary little with changes of speed, but do vary with changes of load. The carburettor meters fuel in proportion to the mass air flow and consequently finds it difficult to differentiate between changes in load and speed. The injection pump, however, being engine driven, is inherently "speed conscious" and can be made separately "load conscious" by an automatic device which proportions its cyclic output primarily to induction pressure; thus, under all conditions of running the optimum mixture strength can be obtained.

Starting.—As with petrol injection fuel is injected near or into the cylinder for which it is intended, deposition on manifold walls is minimised and, therefore, the overall fuel/air ratio to give an ignitable mixture strength in the engine cylinder can be much less than that required with the carburettor. Furthermore, as the carburettor engine in normal operation relies on manifold heat to assist vaporisation, it is obviously at a disadvantage when starting is attempted from cold. With petrol injection, however, where vaporisation is not dependent on manifold heat under normal operating conditions but on the fineness of atomisation and heat derived during the compression stroke, starting conditions conform much more closely to running conditions, and therefore starting can be effected easily.

The above points are of particular importance to short-journey vehicles as, when starting from cold, the reduced overall mixture strength minimises cylinder bore wear caused by the wet petrol destroying the lubrication of the cylinder walls. Furthermore, the warming-up period and the necessity to use a choke (in the carburettor engine) is avoided, with a resultant reduction in fuel consumption.

Fuels.—In the injection engine the fuel is finely atomised by mechanical means; therefore, the formation of a homogeneous mixture is less dependent on the volatility of the fuel, and "safety fuels" can be used with consequent reduction of fire risk.

Two-Stroke Engines.—The advantage of the injection system for two-stroke engines results from the fuel being introduced independently of the air. By suitable injection timing and injector location, fuel loss direct to the exhaust can be minimised.

Road Consumption.—An advantage of the injection system, not obvious on test bed work, can be realised under road operation, as it is possible to prevent fuel being injected when the vehicle is coasting in gear. During coasting with throttle closed, the manifold depression is greater than under any other condition of operation; for example, on one application the coasting manifold depression amounted to 26in of mercury as against 22in, which occurred at idling. This difference of 4in can be arranged to move the pump output control to zero delivery.

Leakage as Affecting Pump Output

Plunger lubrication is effective only in preventing the external leakage of petrol and is of no assistance in reducing leakage from the pumping chamber to the suction ports. This leakage is reflected in the low-speed performance of the pump and is dependent on the clearance between plunger and barrel. Fig. 1 shows some typical performance curves at various injector pressures, from which it can be seen that, if cranking speeds are very low, as is commonly the case in aero-engines, difficulty can be expected in obtaining a start without auxiliary priming, unless adequate excess capacity is provided in the design of the pump. In smaller engines cranking speeds are rarely less than 120 r.p.m., and this, coupled with the lower injector pressures now employed, considerably eases the low speed requirements. Nevertheless, it is desirable that the full pump output shall be maintained down to as low a speed as possible, and, in order to obtain a better appreciation of the problem, an analytical approach was made to determine the relative influence of the various factors. The importance of clearance, clearly brought out in the analysis, stressed the need for some means of making exact measurements of plunger and barrels. As the clearance is of the order of 0·00004in on the diameter, an accuracy to one-tenth of this dimension was essential in the measurement of both plunger and barrel. Measurement of the plunger diameter to this accuracy presented little difficulty, but for the barrel the high length-diameter ratio made most available instruments unsuitable. The ingenuity of the late Dr. G. A. Tomlinson, of the National Physical Laboratory, eventually produced the instrument shown in Fig. 2, with which it was

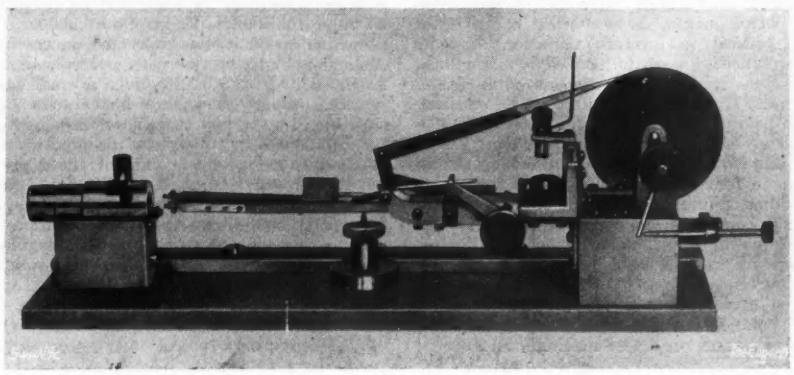


Fig. 2—*Tomlinson Machine for Fine Measurement of Pump Barrel Bores*

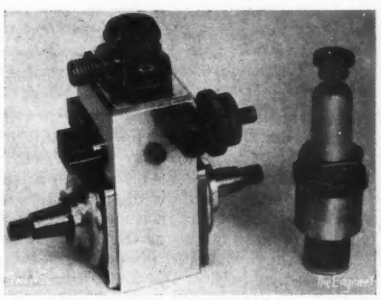


Fig. 3—*Small Single-Cylinder Pump*

possible to measure ovality, bell-mouthing, and other irregularities at any point along the bore with an error not exceeding 0·000004in. As originally designed the instrument had a mechanical magnification of 40/1, the measurements being made by marks scribed on the circular smoked-glass disc, and subsequently viewed and measured under a microscope. Later, the instrument was adapted to project the scribed markings directly on to a screen, the optical magnification being 125/1. Thus variations of 0·000004in in the bore size were shown as deflections of 0·020in, or 0·5mm on the screen, and could easily be measured by a convenient scale.

It has not proved necessary to decrease the working clearance between plunger and barrel for petrol injection pumps, but it is important that a close tolerance be maintained, particularly between the various elements of a

* Institution of Mechanical Engineers, Automobile Division, February 3rd. Abstract.

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‡ Development engineer, C.A.V., Ltd.

multi-cylinder pump. If this is not done, the slope of the speed-delivery curves will differ and close balancing of output will be possible only at one speed.

Balance of Output

One of the advantages of petrol injection is that distribution is improved as a result of the independent metering of the fuel to each cylinder. While in the interests of engine smoothness efforts are made to secure close equality of output from the various lines of a diesel pump, only at full load does this equality have any significant bearing on engine performance and economy. Owing to the flat shape of the specific consumption curve for varying load, quite wide discrepancies over the part load range have negligible effect. The petrol engine, on the other hand, is far more critical to mixture variation, and its performance is greatly influenced by inequalities of mixture strength between one cylinder and another. Thus the means adopted for ensuring a well-balanced delivery from a petrol injection pump are of some importance.

It was thought at first that provision should be made for the adjustment of output from individual pumping cylinders on engine test, so that compensation could be made to suit variations in air distribution of the engine. Experience proved, however, that this was unimportant compared with the interest of service interchangeability, and present practice is to balance outputs to a set of established average figures on a test machine, and accept the slight variation in mixture strength which may occur on the engine due to small discrepancies in the individual air flows to engine cylinders. It is also necessary to ensure that the flow through the individual injectors for a given set of conditions is in close agreement. This presents no difficulty as the injectors used are mainly of the simple poppet valve type, and consistency in flow automatically follows when they are produced to normal manufacturing tolerances.

General Design Features

The most obvious external difference between injection pumps designed for diesel and petrol injection engines is the much decreased bulk and weight of the latter. This has been largely due to the policy of designing each pump to suit the particular engine concerned in contrast to the diesel pump which, for economic reasons, must be suitable for a wide variety of engines and is rarely called upon to operate at the limit of its capacity. Furthermore, the wide divergence in the types of engine concerned (V, radial and H, &c.) made standardisation impossible in the aircraft field. As an example, a six-cylinder petrol injection pump was designed for a maximum output of 620 cubic millimetre per stroke and had a weight of 17·5 lb and overall dimensions of 12·8in by 8·7in by 3·35in. A diesel pump modified for this application would measure 14·4in by 10·2in by 5·1in and weigh 24 lb. In the case of the petrol injection pump, some of this weight saving was due to the adoption of three plain bearings for the camshaft as against the two ball races of the diesel pump, permitting a smaller camshaft diameter and a general reduction in the dimensions of the lower half of the casing. The use of plain bearings raised no difficulty, since a supply of lubricating oil was necessary for the lubrication and sealing of the elements. Apart from some minor troubles due to unsuitable material, the plain bearings were completely satisfactory.

The smallest practical pumps made so far were designed for a two-stroke engine of only 200 cubic centimetre per cylinder, intended as a starting engine for large piston and turbine aero-engines. A twin-cylinder version has a bore and stroke of 5mm and an output of 65 cubic millimetre per stroke at 6000 r.p.m., at which speed it has operated successfully. A single-cylinder version with integral camshaft is shown in Fig. 3, alongside a normal 14mm sparking plug, its square appearance being explained by the fact that it was designed as a development unit to explore the practicability of these small pumps. One of these pumps gave a perfectly atomised spray, at an output of 0·75 cubic mm per stroke, with complete regularity, thus disposing of the contention that the development of small injection engines is impeded by limitations of the injection pump.

Injector Design

By comparison with a diesel injector the requirements of a petrol injector would not at first sight appear to be exacting. The precise point at which injection starts and finishes is not critical, and injection pressures can be moderate. Considerable care must, however, be exercised in the selection of the injector location to ensure that the entire air charge is evenly saturated with fuel and that none of the fuel spray is allowed to impinge on the walls of the passages or cylinder. In small cylinder heads the space occupied by valves and plugs frequently makes it difficult to select the optimum position for the injector, and the problem is further complicated by considerations of accessibility, particularly in multi-cylinder engines. Thus there is strong justification for reducing injector size to the smallest possible dimensions consistent with reliability.

With injection direct into the cylinder, and to some extent also with port and manifold injection, there is very little time in which to complete the thorough mixing of air and fuel which is essential if high specific output and good fuel economy are to be achieved. It is for this reason that injection on the compression stroke, as in the oil engine, is undesirable, and it is found in practice that injection should preferably commence as soon as a definite flow of air into the cylinder is established. There are indications that some degree of turbulence in the cylinder is beneficial, though for this to be effective it should occur during the induction stroke, or at least well before the end of compression. The injector type and location should be selected with a view to assisting the mixing process and good atomisation is an obvious requirement.

It has frequentiy been found on test that better results have been obtained by injecting into the manifold at some distance from the inlet valve. This must not be carried so far as to permit disturbances set up in the manifold by adjacent cylinders to interfere with the air flow in the vicinity of the fuel spray, or the inherent distribution of the injection system will be lost. Examples of injector location are shown in Fig. 4.

Since the air into which the petrol is injected is at low pressure, multi-hole injectors of the diesel type are in general unsuitable, except in very large cylinders, unless steps are taken to soften their high penetration by the addition of swirl or high frictional resistance. The latter expedient is not recommended since the atomisation of plain orifice nozzles is largely a function of jet velocity, and the reduction of penetration is therefore achieved at the expense of a coarser spray; this reacts unfavourably on the vaporisation of the fuel.

Application to the Engine

Contrary to the case of the oil engine, the injector does not of necessity have to be located in the engine cylinder head, as satisfactory results have been obtained with the injector located both before and after the inlet valve. It is the authors' experience, when applying petrol injection to the conversion of conventional automotive four-stroke engines, that the results obtained with injection before the inlet valve are, if anything, superior, and that problems of injector cooling are eliminated. If, however, the engine is specifically designed to take full advantage of the injection system in regard to such features as charge-stratification, two-stroke operation, or the use of low volatility fuels, then direct cylinder injection is the obvious choice.

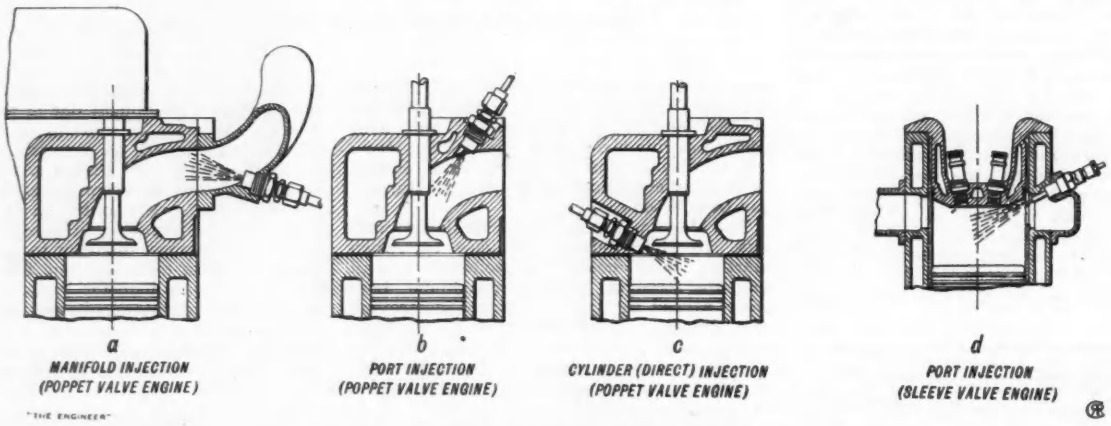


FIG. 4—*Typical Injector Locations for Four-Stroke Engine*

Fig. 4*a* illustrates a typical nozzle location for manifold injection, necessitating a minimum amount of engine redesign when the injection system is applied to an existing engine. Very satisfactory results have been obtained with this arrangement on a four-cylinder car engine of 1·4 litres capacity. The importance should be noted of locating the injector relative to the air flow so that direct deposition of fuel on to the manifold walls is prevented.

Fig. 4*b* shows a typical injector location for a port injection system. While an arrangement of this form has been used successfully on a six-cylinder engine of about 8 litres capacity, when tried on the small engine, referred to above, the performance at full load was almost identical to that obtained with manifold injection; at less than half load, however, persistent misfiring occurred, indicating that injector location for port applications is rather critical.

Fig. 4*c* gives a typical example of direct injection. Such arrangements have been used successfully in aircraft engine applica-

tions, but, in the authors' experience on small engines (of about 350 cubic centimetres cylinder capacity), difficulty has been experienced owing to the spray striking the cylinder wall—resulting in unburnt fuel and lubricating oil dilution—thus adversely affecting performance. No doubt suitable injector location and spray pattern could be developed to give satisfactory operation; on small engines, however, little energy has so far been expended on this problem, owing to the success attained with the simpler manifold and port injector locations.

The sleeve valve engine application in Fig. 4*d*, shows an injector location which has been used with some success, this arrangement allowing direct injection into the engine cylinder, whilst the nozzle is located in the manifold and is thus remote from combustion temperatures. Direct deposition of fuel on the far wall of the cylinder is avoided by the high degree of rotary swirl imparted by directed inlet ports.

Conclusion

The development work described has shown that the adaptation of the conventional jerk pump system to suit the special needs of the petrol injection engine presents no insuperable problems. This injection equipment is, however, costly, and cannot, as in the oil engine, be offset by the elimination of the ignition system. Consequently, for the transport engine in particular, a departure from accepted jerk pump design may be desirable in the interests of simplicity and low cost. At the same time, the scarcity of reliable evidence in support of the case for petrol injection under service conditions has so far made it doubtful whether the effort involved in such a development is really justified.

Experimental Third-class Sleeping Cars

The first of six third-class sleeping cars of an entirely new design was completed at the end of December last by the London and North Eastern Railway Company, under the supervision of Mr. A. H. Peppercorn, the chief mechanical engineer. The new vehicles, which are all being built at Doncaster, are experimental and although they will supplement they will not at present replace existing third-class sleepers. We recently had an opportunity to inspect the first complete new vehicle and found it a very considerable advance on the present design of third-class sleeping-car in this country.

The present standard third-class sleeping-car has four berths in each compartment and provides accommodation only for lying down with rugs and pillows. The new cars each have eight single and four double berth compartments with full bedding and an individual wash-basin.

In laying out the new cars a considerable amount of space has been saved by arranging the adjoining berths in each cabin alternately in the "upper" and the "lower" positions. The photograph we reproduce shows one of the double compartments with upper berths. On either side of this compartment is a compartment with lower berths arranged immediately below those shown in the illustration. At one end of the car is a fully equipped attendants' compartment and at the other end there are two lavatory compartments.

The general construction of each of the new cars follows standard L.N.E.R. practice, with a steel panelled timber framed body mounted on a rigidly trussed underframe. Each vehicle is carried on two bogies of the compound bolster type and is fitted with Buckeye couplers and Pullman Vestibule gear.

A particularly noticeable feature of the new sleeping cars is the excellent heating and ventilating both in the compartments and the vehicle as a whole. Thermotank equipment is fitted and at the head of each bed is a Punkah louvre, with which each passenger can regulate the flow and temperature of the incoming air according to his requirements. The cars also have ordinary steam heating equipment, which gives a choice of alternative systems or a combination of both. The corridors are heated along their full length through floor grilles.

Current for the water-heating equipment is generated by a 50V, 100A dynamo and the current for lighting and the ventilating system by a 24V, 125A dynamo, both being driven by belts from pulleys mounted on the axles. Two banks of cells are provided to form the necessary storage capacity, that for the water heating equipment consisting of twenty-five cells of 279Ah capacity and for the lighting, twelve cells of 360Ah capacity.

Diesel-Electric Main Line Locomotive Trials

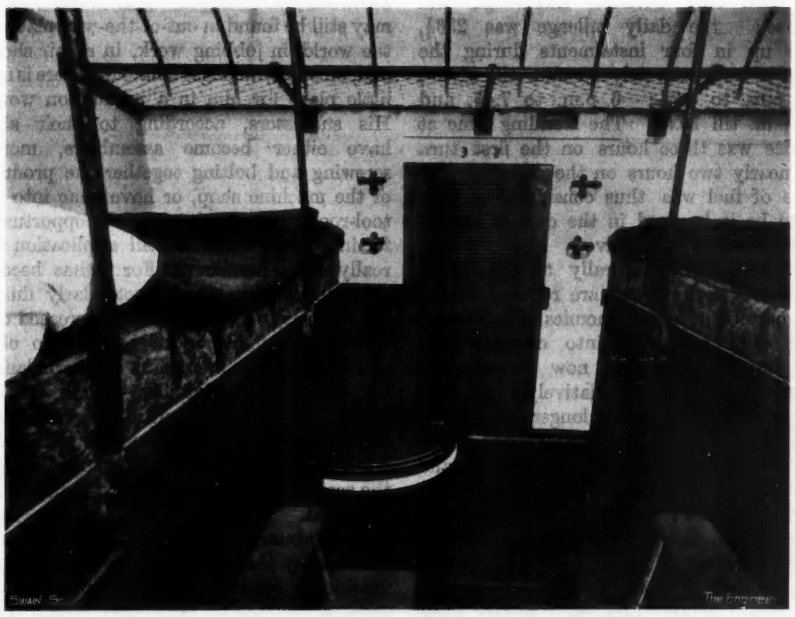
The first diesel-electric locomotive for main line service, the 1600 h.p. "No. 10,000" of the London Midland Region, underwent dynamometer car trials on the St. Pancras-Manchester main line on Wednesday and Thursday, 14th and 15th January, 1948. For the purposes of these trials a train was made up of twelve vehicles (including dynamometer car), weighing in all 393 tons tare, equivalent to the maximum load laid down to be worked to the same timings by standard 4–6–0 (5X) express passenger steam locomotive.

On the first day of the trials, "No. 10,000" worked the test train from Derby to St. Pancras, with intermediate stops at Leicester and Bedford. On the second day, a run was made from St. Pancras to Manchester (Central)—including the severely-graded Peak Section—with stops at Bedford, Leicester, Derby and Millers Dale. Finally, the test train returned from Manchester to Derby with one intermediate stop at Millers Dale. No attempt was made to set up any exceptional performance, the object being to adhere as closely as possible to normal service conditions, but the diesel-electric unit maintained the schedules laid down and, in fact, slightly improved upon them.

On the first day's run from Derby to London, the initial 29½ miles from Derby to Leicester were covered exactly in the 35 min. scheduled, including a permanent-way restriction costing about 2 min. From Leicester to Bedford (South) the 49½ miles were run in 55½ min. start-to-stop, or at an average speed of 53·5 m.p.h., there being a gain of 3½ min. on schedule over this section; the minimum speed at Sharnbrook Summit was 42 m.p.h. Finally, the 49½ miles from Bedford (South) to St. Pancras were covered in 55 min. (including a permanent-way slowing at St. Albans), compared with a booked allowance of 58 min. On the second day's run from St. Pancras to Manchester, the train, although delayed for 4 min. by signal checks and permanent-way restrictions between St. Pancras and Leicester, arrived at Derby 3 min. ahead of schedule. The severe gradient of 4½ miles between Millers Dale and Peak Forest, including three at 1 in 90, was climbed in 8 min., start-to-pass, compared with the booked allowance of 10 min. Arrival at Manchester (Central), 61½ miles from Derby, was 2 min. early.

Verein Deutscher Eisenhüttenleute

The first meeting of the Verein Deutscher Eisenhüttenleute since the war took place in Dusseldorf in the Europa Palast Theatre, on Friday, September 26, 1947, when over 2000 members accepted an invitation to attend. The chair was taken by Dr. Ing E. Herzog, the chairman of the board of management of the August-Thyssen-Hutte, A.G., and the board of management of the Verein was elected, and a financial statement for 1946 presented. Dr. Ing K. P. Harten then reported on the activity of the Verein, and its reconstruction since the end of the war. Efforts are being made to republish and develop the periodical *Stahl und Eisen*, to form a new link between members and management, and to regain contact with the technological work of other countries. It was reported that 95 per cent of the former members in all zones of Germany have been registered again. A good start has been made with most of the special committees, and last year, more than fifty meetings, seven of these being plenary meetings, took place. Unemployed members are being cared for, especially those from the East. Care is being exercised in the training of a new generation of metallurgists in technical and vocational schools, as well as in works practice, and Dr. Harten invited all works to co-operate in this necessary work. The papers read included the following:—"Interdependence of Blast Furnace Burden and Fuel Economy in Iron and Steel Works," by Dip. Ing H. Schumacher of Duisberg-Hamborn; "Blast Furnace Slags for Reconstruction Work," by Dr. Phil. F. Keil of Dusseldorf; "Iron Industry and Farm Produce," by Prof. Dr. Phil. H. Kappen of Bonn; "Importance of High-Grade Steel for Reconstruction Work," by Dr. Ing F. Brühl of Essen, and "Development of Rolled Steel as to Demand and Manufacturing Programme," by Dr. Ing W. Asbeck of Duisberg-Hamborn. All these papers had a direct bearing on the problem of reconstruction and present-day material shortages.



Double Upper Bunk Compartment

THE ENGINEER

FEBRUARY 6, 1948

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NOTICE TO READERS

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No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

For Subscription Rates, see page 2 of Advertisements.

OIL-FIRED STEAM LOCOMOTIVES

IN Great Britain at the present time the difficulties of the railway motive power position might almost be summarised under three forms of shortage, those of locomotives, fuel, and manpower, to which the shortage of housing accommodation could well be added as a contributory factor. The shortages in locomotives and manpower are largely related, since if more men were available for shed and workshop duties, more engines could be kept in first-class trim for the road, and the number of failures would be reduced. With coal it is another matter. In recent years devices have been introduced with the object of lessening the time taken over such shed duties as smoke-box and fire-grate cleaning, while in other directions the use of totally enclosed valve motion, working in an oil bath, has the same general object in view, the reduction of maintenance time and charges.

While the present programme of the British railways in converting numbers of steam locomotives to oil-firing has been launched with the primary object of saving coal, oil-firing in itself possesses certain potential advantages for servicing which, if larger numbers of locomotives were converted, might make an appreciable difference in motive power availability. The periodic cleaning of smoke-boxes and fire-grates, with the attendant need for disposal of ash and clinker, is eliminated and the transport of coal, purely for locomotive purposes, is reduced, together with the need for operating long trains of returning empties to the collieries. Again the use of oil would largely eliminate those exasperating occasions that are, unhappily, too frequent nowadays, when a good engine and a keen crew are sorely handicapped by bad coal. In the initial stages many difficulties have been experienced with the oil-fired engines, and longer use will be necessary before the effects on the life of fire-box sheets, flues and tubes will be apparent. A trouble met with in America, the abrasion of tubes and tube plates, will not arise here, at any rate on the Great Western engines, as sand guns have not been fitted. On the runs described elsewhere in this issue the Great Western locomotives concerned were, clearly, very competently handled and the article, when completed in our next issue, will be found to bring out the striking difference in fuel consumption over routes of dissimilar physical characteristics. If the primary aim is to save coal, then it would seem that the oil-burning locomotives could best be used on routes where the demands for steam are intermittent, and there is much standing and coasting time in the course of a single journey. Yet it must be remembered that the utilisation of a locomotive can prove an entirely dominating factor in its success or failure as an efficient motive power unit. At a recent meeting of the Institution of Locomotive Engineers, Mr. Bulleid cited the case of Sir Nigel Gresley's celebrated 2–8–2 express engine, "Cock o' the North," which proved very efficient on the Vitry test plant and performed prodigies of weight-haulage on the Orleans road. But in regular service in Scotland the utilisation of the engine was so poor that the coal consumption per train mile, month in, month out, was excessive. In Great Britain, perhaps to a greater extent than in most other countries, the success or failure of new motive power is closely bound up with the extent to which it can be utilised. During the first season of regular working the "Cock o' the North" was used only between Edinburgh and Dundee; the daily mileage was 236½, made up in four instalments during the hours of approximately 10 a.m. till 11.45; 2.40 p.m. to 4.25; 6 p.m. to 7.45, and 9.30 p.m. till 10.55. The standing time at Dundee was three hours on the first turn and nearly two hours on the second. The waste of fuel was thus considerable. Nor would be it lessened in the case of an oil-burning steam locomotive.

Thoughts turn naturally to the diesel, in which standby losses are reduced to the minimum. But here economics of a different kind must be taken into consideration. The diesel-electric units now becoming so popular in America are relatively expensive; they are also considerably longer and heavier than steam locomotives of equivalent power and introduce problems of control and braking which, as yet, do not appear to be fully appreciated. If full benefit is to be derived from their introduction, it must be in the direction of greatly increased utilisation, so that by doing the weekly work of two steam locomotives they justify their high capital cost. It is in this direction that some difficulty may be experienced here in arranging suitable turns, as the length of continuous run is not to be compared with those across the American continent. But the conversion of existing steam locomotives to oil-firing or even the building of new oil-burners, does not so much involve the obligation to secure intensive use. The direct saving in coal is effected and the locomotives themselves have a higher availability as a consequence of the reduced time of servicing. The prime desideratum of a railway motive power stud is above all flexibility, and in that respect the steam locomotive is still supreme. The oil-firing apparatus first used on the Great Western Railway appears to have the great merit of being readily adaptable to a variety of locomotive classes, of both size and power. On the Southern Railway types ranging from the West Country "Pacifics," to the veteran 4–4–0 passenger engines, designed by Dugald Drummond and built for the London and South Western Railway nearly fifty years ago, have been equipped, and from our own observations with every success. Here again the oil-burning engines are being used on intermediate duties, involving relatively short runs, many stops, and inevitably a high proportion of standing time. It is on such duties that saving of coal may particularly usefully be effected. That saving was the original object of conversion. But oil is now becoming less abundant in this country. Further conversions, beyond the existing programme, if undertaken, will therefore, it seems, have to be justified on the normal grounds of economy, convenience and reliability in operation rather than upon the need to save coal.

FINE LIMITS

THERE is no engineer but will mourn the gradual passing of the journeyman machinist, able to do almost any workshop job, to turn a shaft or bore a hole to within a few thousandths of an inch by the use of rule and calipers alone, or to fit one part to another accurately with chisel, file and scraper, full of ingenuity in tackling the difficult or awkward job. But passing he is. Though he may still be found in out-of-the-way places of the world, in jobbing work, in repair shops, and, ofcourse, amongst amateurs, there is now little place for him in a production works. His successors, according to their skill, have either become assemblers, merely screwing and bolting together the products of the machine shop, or have gone into the tool-room, where, despite less opportunity for ingenuity, there is still application for really skilled handicraft. For it has become increasingly recognised, particularly during the last thirty years, that the increased cost in the machine shop of working to close tolerances can be more than counterbalanced by substantial reductions in the cost of fitting. As development of machine tools has advanced, so has it become possible to work to closer and closer tolerances, so that the scope for skilled handwork in fitting has dwindled.

The primary restriction upon the degree of accuracy that can be surely repeated in a machining operation is, of course, that of measurement, and if very close tolerances are to be adopted productively not only must the

machines be capable of operating within them, but the means of measurement and inspection must also be brought into the shop and must also be capable of doing their work at a speed comparable with the productive rate of the machines. That those requirements for rapid precision production are fully appreciated is made evident at the Gauge and Tool Exhibition, which has been open in London for the past fortnight and closes to-day. Many of the measuring and inspecting devices there shown are adequately robust for the production floor. More surprisingly they are capable of measurement to a degree of accuracy undreamt of thirty years ago, except by the use of special laboratory equipment. No longer do manufacturers of gauges speak with respect of half-thousandths of an inch. They talk glibly in terms of half-ten-thousandths and of microns and have instruments to show, which, using that comparative method which, to some extent, evades temperature effects, can, it is claimed, measure accurately to such limits. Nor has the machine tool manufacturer failed to do his part. Production tools are now becoming available that can match inspection instruments in the accuracy with which they will do their work. Engineers may, indeed, entertain some doubt as to whether such close limits of accuracy (which the instruments are undoubtedly capable of measuring) are in reality attained in the workpieces themselves. For the presence of dirt, uneven support, unequal temperature distribution or even a thin film of oil upon the workpiece can all influence a dimension in so small a unit as a micron, and none of those factors can be brought wholly under control in a production shop. It must, too, also be remembered that so close an accuracy is not attained for nothing. Machines capable of its attainment are more costly to install than those of less extreme accomplishment. Gauges and instruments themselves are not inexpensive items. The time taken to complete a part to very close tolerances may be increased or a greater number of operations may prove necessary. Even the quality of the raw material to be machined may have to be called in question because fine surfaces must not be marred by flaws or blemishes that would be inconsiderable were coarser limits adopted. Yet the fact must be granted that through the skill and ingenuity of gauge and tool manufacturers in pressing towards ever greater precision the powers and abilities of designers are being widened. Wisely employed these powers can be used both to improve and to cheapen engineering products.

But though we may be lost in admiration of the ingenuity and skill that has made possible the construction of such accurate means of production shop measurement, is there not also a certain danger in the very facility with which measurements in microns can now be made? It is still true that "the sight of means to do ill deeds makes ill deeds done." How often already is a closer tolerance specified upon a drawing than need be? How often, indeed, are limits placed even upon a dimension that has in reality no dimensional importance? There is, of course, no need to point out to the practical man in the shop that drawings showing dimensions to the third and fourth place of decimals, however impressive to look at, represent, in fact, high costs in tooling, machinery and inspection, and complication in progressing. But designers, and more particularly, perhaps, draughtsmen, are in a different category. Both, when in doubt as to how close limits should be, are inclined to play safe by specifying the finer finish and the closer tolerance. How many man-hours are wasted and how many expensive tools are used, we wonder, because designers and draughtsmen have been insufficiently influenced by shop conditions? For we doubt whether liaison between shops and drawing offices can ever become so close, even in the best-organised of firms, that every tolerance specified is judged correctly to be economically the soundest. Thus, in congratulating the exhibitors at the Gauge and Tool Exhibition upon the precision of their instruments, we would, too, caution those who have visited the show or read about it in our pages not to be led away by enthusiasm into thinking that because it is now possible to measure to such fine limits it is necessarily desirable to work to them. These modern precision instruments and gauges do indeed open up to manufacturing skill new potentialities. The improvement of the whole art and science of engineering has been, in fact, and always will be, locked up with the development of precision in measurement. But manufacture to a hundredth of an inch or so is still adequate enough for many parts, and the bulk of the material that has to be machined to finer limits will still be satisfactory in performance and adequately interchangeable if made to tolerances measured in thousandths rather than in microns. Closer tolerances are only to be specified where nothing less accurate will serve to make so good a job.

Obituary

ORVILLE WRIGHT

THE whole world will hear with deep regret of the death on Friday last week, January 30th, at his home in Dayton, Ohio, of Mr. Orville Wright. He and his brother, the late Mr. Wilbur Wright, who died in 1912, designed and built the first power-driven aeroplane to fly carrying a pilot.

Orville Wright was born at Dayton, Ohio, on August 19, 1871. He was the son of Bishop Wilton Wright, a minister and an editor of a religious journal, and he received his early education at schools at Cedar Rapids, Iowa; Richmond, Indiana, and Dayton, Ohio. While still at school he started a job printing office, using a home-made printing press, and with his brother Wilbur he published about 1890 a newspaper and a weekly journal. Two years later the two brothers formed the Wright Cycle Company, and started a small business in Dayton for the sale and repair of bicycles. At a later date they manufactured the Van Cleve cycle and other models. But as this business was of a seasonal character they had time and opportunity to turn to other interests, and particularly to that of the science of flight. Earlier they had constructed toy helicopters, and they made themselves familiar with the background of aeronautical thought at that time, studying the writings and experiments of Otto Lilienthal, Octave Chanute, Professor Langley, Hiram Maxim and John Stringfellow. They continued to follow up the work of these early investigators and others working upon the problem. About 1899 they designed and constructed a large kite, which was flown with the object of testing their own ideas. In the autumn of the following year they built and flew a glider which was a biplane with a supporting area of about 170 square feet with a horizontal elevating rudder in front of the wings. It embodied an ingenious system of staying devices consisting of adjustable wires.

The experimental flights were made at Kitty Hawk among the sand dunes of the North Carolina coast. Since the results of the first tests showed disagreement between theory, as then known, and the practical results actually obtained, an improved wing formation was tried out the next year, with the curved wing contours of Lilienthal. But the results of the second model also proved unsatisfactory. The brothers therefore constructed a small wind tunnel in their Dayton bicycle works, and started to seek for more accurate data on which to base the calculation of aerodynamic phenomena. New recording and measuring instruments were designed and the centre of pressure on

ORVILLE WRIGHT

inclined surfaces was successfully measured. The experimenters found that contrary to the accepted theory of that time, any decrease in the angle of attack caused the centre of pressure to move backwards instead of forwards, as then stated in the textbooks.

A third glider incorporating the knowledge gained was completed in 1902. Like its predecessors it was a biplane, with a supporting area of about 300 square feet. It had a horizontal elevating rudder at the front and a vertical rudder at the rear. As many as 1000 glides were made with this model, the longest lasting twenty-six seconds and covering 622ft. Being now reasonably satisfied with this aircraft the next problem to which attention was turned was that of the aerial propeller, of which at the time but little was known. The Wrights worked out a new propeller theory, the results of which agreed with calculated values to close upon 2 per cent.

Work on a power-driven aircraft was started in the early part of 1903, and their by now well-tried system of controls was retained. A petrol engine was fitted to the craft. It was made in the Wright workshops and was a four-cylinder, four-stroke unit of simple and original design. It drove two wooden propellers in opposite directions through chains. In tests at Kitty Hawk, carried out on December 17, 1903, the

machine rose four times from level ground against the wind. These flights, short though they were, were the first authentic and successful flights of an engine-driven aeroplane carrying a pilot. The flights lasted from twelve to fifty-nine seconds. On one of the lengthier flights a distance of 852ft was flown at a speed of over 9¾ m.p.h.

Further flying trials were carried out at the Huffner Pasture, near Dayton, in 1904, when over 100 flights were made. Larger distances were covered reaching up to 11 miles, and speed was increased to about 38 m.p.h.

During the next few years more development work was done, and the brothers, although shunning publicity, felt ready to approach the United States War Department. It declined at that time, however, to take any interest in their work. Consequently, it was decided to get in touch with some other military powers, and England, France and Germany were approached. In 1908 Wilbur Wright flew successful trials at Le Mans, in France, and interest was widely aroused in Europe. Meanwhile, Orville Wright stayed in America. By this time the U.S. Government was at length becoming interested, and he was able to make successful flights at Fort Myer, Virginia, in a machine ordered by the United States Government. During the Fort Meyer trials Mr. Orville Wright sustained an accident caused by a propeller fouling a stay wire, and for a time he joined his brother in France during his period of convalescence.

The American Wright Company was formed with wide backing in the winter of 1909–10. Orville Wright was vice-president from its formation until 1912, and president from 1912 to 1915. During the 1914–18 world war, he made many inventions in differing fields of engineering outside his aeronautical work. The work done by the Wrights began to be publicly recognised during this period. After the premature death of Wilbur Wright in May, 1912, in Dayton, following an attack of typhoid fever, Orville became the sole representative to whom honours and medals were given from American, English, French, German and Austrian universities and scientific institutions. Amongst other honours Orville was elected an Honorary Fellow of the Royal Aeronautical Society of London and the Wilbur Wright Memorial Lectures were founded, which, in successive years, paid just tributes to the pioneer work done by the two Wright brothers.

Orville Wright was made a member of the Daniel Guggenheim Fund for the Promotion of Aeronautics, and he served on the National Advisory Committee for Aeronautics, and was governor-at-large and chairman of the Contest Committee of the American National Aeronautic Association.

In 1929 he was awarded the first Guggenheim medal for the design and construction, with his brother, of the first successful engine-propelled aeroplane. The medal was presented at Washington in 1930, on the occasion of the celebration of the fiftieth anniversary of the founding of the American Society of Mechanical Engineers.

One of the later recognitions of his work was the conferring upon him here in 1944 of the Honorary Life Membership of the Institution of Mechanical Engineers. The Certificate of Membership was presented to Mr. Orville Wright at a luncheon at the Engineers' Club in Dayton, Ohio, at which there was a representative gathering of engineers and aircraft constructors. The presentation was made by Mr. E. D. Smith, a member of the Dayton Section of the American Society of Mechanical Engineers.

When the first Wright aeroplane was no longer needed, it was offered by Orville Wright to the Smithsonian Institution at Washington, which administers the United States National Museum. Unfortunately there seems to have been some difference of opinion in those early days as to the respective merits and priority of the work of the Wright brothers and that of Dr. Langley, and the offer of the Wright record-making machine was declined. The dispute continued over a period of years, and eventually an investigating committee was appointed. A later report of the Smithsonian Institution recognises that it was ill-advised in some respects and that should the opportunity occur a place of honour for the Wright machine should be found in the Museum.

Meanwhile, through the kindness and interest of Mr. Griffith Brewer, a Past-President of the Royal Aeronautical Society in London, and a friend and collaborator with the Wright brothers since the French trials, the first successful power-driven aeroplane was secured for the Science Museum at South Kensington, where it has been prominently displayed for many years. The loan is, we understand, for an undetermined period of years, but in case the exhibit should ever be required for exhibition in America, the Museum authorities, with the assistance of the de Havilland technical school, have made an exact copy of this famous exhibit, thus ensuring that Wilbur and Orville Wright will be permanently honoured in the Science Museum, as befits the outstanding work of gifted and able engineers and aeronautical inventors.

E. E. R. TRATMAN

FOR more than fifty years, the American Engineering News and many of the descriptions of American mechanical and civil engineering works which have appeared in THE ENGINEER, have been prepared by Mr. Edward Ernest Russell Tratman. It is, therefore, with great personal regret that we have recently received news of his death which occurred at his home at Wheaton, Illinois, on November 30th last.

Mr. Tratman was born in this country at Bristol in 1863, and studied engineering under the late Mr. Edward Wilson. He went to the United States of America in 1884 to take up an appointment with the Long Island Railroad, and for the remainder of his long life he lived and worked in that country. In 1886, Tratman joined the New York editorial staff of our American contemporary, *Engineering News-Record*, and ten years later he was transferred to Chicago as Western Editor of that journal, a position which he occupied until his retirement in 1932.

Throughout the whole of his working life, Tratman's particular interest was in matters concerned with railway engineering practice, and his book on "Railway Track and Track Work," the first edition of which appeared in 1897, has through the years been recognised as a standard work both in this country and overseas. In his early days in America, Tratman acted as special agent to the United States Department of Agriculture on investigations into wooden railway sleepers, and in later years he regularly prepared texts on railway maintenance and construction for the International Correspondence Schools. He also contributed a great deal to the work of the Committee on Yards and Terminals of the American Railway Engineering Association, of which he was a charter member, and for many years he was responsible for the compilation of its bibliographies. He was a member of the American Society of Civil Engineers, and for twenty years was the secretary of the Illinois Society of Engineers, of which Society he was elected President in 1923.

So far as can be traced from existing records, Mr. Tratman's association with THE ENGINEER began shortly afterhe arrived in the U.S.A., and his services for this journal must have thus been faithfully continued without interruption for more than half a century. After his retirement, his activities on our behalf in no way abated, and, in fact, right up to the time of his death he was engaged in the preparation of articles for these columns. We mourn the ending of our long and cordial association with Mr. Tratman, at the same time expressing our appreciation of his services which have enabled us to present regularly to our readers lucid accounts of many outstanding American engineering and industrial developments.

Letters to the Editor

We do not hold ourselves responsible for the opinions of our correspondents)

THE SURVIVAL OF THE PADDLE BOAT

SIR,—I was interested in the letters in the current issue of THE ENGINEER, and hasten to assure Mr. Clarke that "Monarch" is still on the active list, has been thoroughly reconditioned and is now taking her winter rest after a good season, but as my article was confined to vessels built in the last fifteen or so years, this boat, in common with a number of other veterans could not be included.

I do not anticipate getting into trouble with any of my Scottish readers, who would be more likely to challenge Mr. Melville's statements. While it is true that originally the Glasgow and South Western Railway's steamers were handed over to the London, Midland and Scottish Railway, the latter in turn by degrees passed them over to the Caledonian Steam Packet Company in order that they might call at certain piers that were denied the railway company, while with the grouping actual ownership was immaterial.

In saying that "Jeannie Deans" is the fastest Clyde paddle steamer, it was not intended to imply that there never had been faster, as her former sister "Waverley" (alas! a war casualty) as well as "Glen Sannox" and other vessels were capable of speeds of over 19 knots. The last mentioned was, however, a very expensive vessel to run, which probably accounted for her relatively short life.

It would, perhaps, have been more strictly accurate to state that "Jeannie Deans" was the first Clyde paddle boat with triple expansion three-crank engines; this was what was intended. I imagine Mr. Melville has not been on this vessel since her extensive reconstruction or he would hardly say she was inferior to any paddle boat on the Clyde, but *chacun à son goût*.

G. W. TRIPP,

Bromley, Kent, January 27th.

BOOKS RECEIVED

Unit Heaters. By S. E. Nelson. London: Emmott and Co., Ltd., 21, Bedford Street, Strand, W.C.2. Price 1s. 6d.

Radio Engineering, Vol. I. By E. K. Sandeman. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 45s.

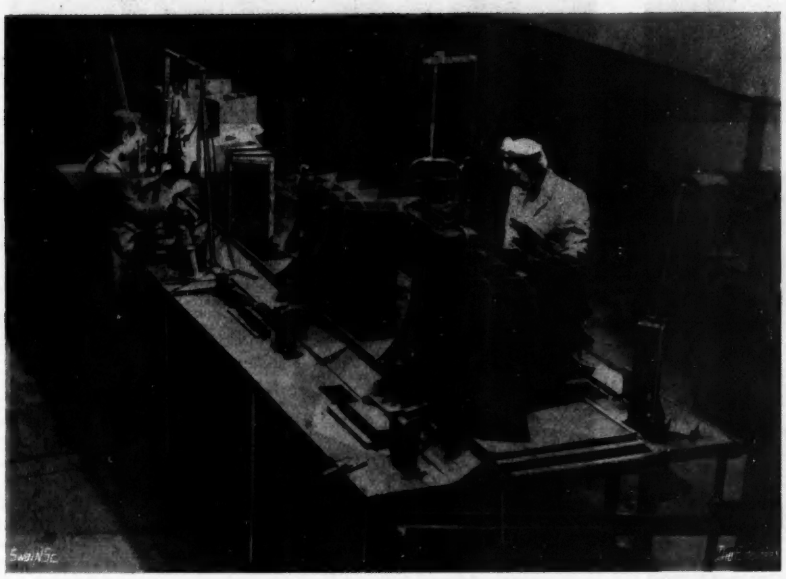
Sequential Analysis. By Abraham Wald. London: Chapman and Hall, Ltd., 37, Essex Street, Strand, W.C.2. Price 24s.

Algebra. By A. Page. London: The University of London Press, Ltd., Little Paul's House, Warwick Square, E.C.4. Price 18s.

Planned Assembly of Hydraulic Brake Components

IT was with considerable interest that we witnessed recently a film and demonstration showing one of the methods used by the Lockheed Hydraulic Brake Company, Ltd., to improve output in its factory at Leamington Spa.

The firm states that reorganisation to increase output could have been achieved with ease by extending present equipment and using more factory space and a larger labour force, but the aim was to obtain increased output within the existing framework. A complete review of production methods was made, in which particular attention was paid to assembly methods.



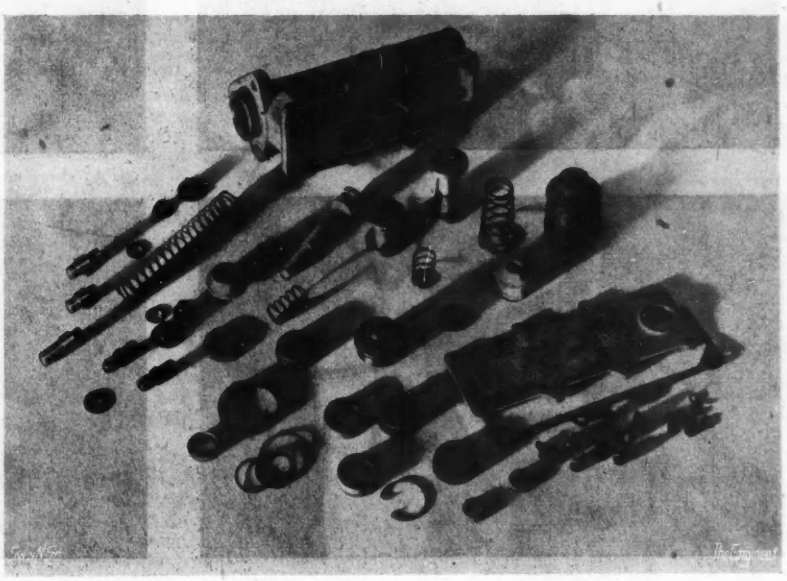
COMPLETE ASSEMBLY BENCH UNIT

As an example of what can be done by what the firm terms "process planning," perhaps more commonly known as time and motion study, the film clearly illustrated the results obtained in the assembly of tandem hydraulic master cylinders for Lockheed brakes. Direct benefits resulting are said to be a saving of bench space and of floor space of the order of 50 per cent for a specified output, and a reduction of assembly time to not more than one-third of the time previously allowed. As the scheme has only been working a short while there is a probability that the time saving will be even greater. In addition, the work is considerably lightened, and operational fatigue with its ill-effect on output towards the end of the day is greatly reduced. Other but not so obvious advantages are that for a given output lower contingency stocks suffice, and a direct check on the efficiency of the machining operations is obtained.

Assembly of Master Cylinders

The assembly of the Lockheed tandem master cylinder, which has fifty-seven parts, was finally planned to be done on the bench illustrated above. Assembly must follow a specific sequence, and the study that led to the introduction of the bench fell into two main parts, devising assembly methods that were quicker, and breaking the sequence down into a series of operations which would all take the same time within a second or two. There are many different types of cylinders and the demand for any one type may fluctuate, so that at one time it may be necessary to have an operator at every assembly station, whereas at other times two operators can produce the required output. Under the system that was in force until recently there could be a considerable variation between the maximum and minimum assembly times for a batch of cylinders. Where one operator is responsible for all assembly functions this is permissible, though undesirable, but where the assembly is to be carried out by a team it cannot be permitted.

It was therefore necessary to investigate the whole of the assembly sequence to determine which operations regularly took a long time in relation to the others, and which operations showed considerable variations in the times taken. In the first category a testing sequence of operations was outstanding. Fitting a circlip in position was typical of the second. For the long-time operations means had to be devised to reduce the time taken; for the variable-time operations means had to be devised to allow the operation to be carried out regularly to a timed sequence.



COMPONENTS OF TANDEM MASTER CYLINDER

Shop Lay-Out and Assembly Bench

Before the actual assembly sequence now employed for a tandem master cylinder is described, it may be as well to give a brief description of the shop lay-out. An endless mechanical conveyor is used for delivering cylinder bodies to the bench assembly lines and for conveying assembled cylinders to the warehouse. The assembly lines run at right angles to the mechanical conveyor. Each line consists of two assembly benches with the necessary jigs and fixtures permanently mounted.

Nests of containers for the various parts are mounted between the assembly benches in such positions that each operator can reach the necessary parts without moving station and without stretching.

The parts containers are mounted on steel plates which rest on top of a roller conveyor. There are four plates carrying parts containers, which are specially designed to suit the parts to be carried. Each container holds about half a day's supply of parts and is replenished twice a day. When a change over from one type of cylinder to another is to be made, the containers on their steel plates are pushed off the roller track to a truck with a roller platform at exactly the same height, and other containers filled with the correct parts are substituted.

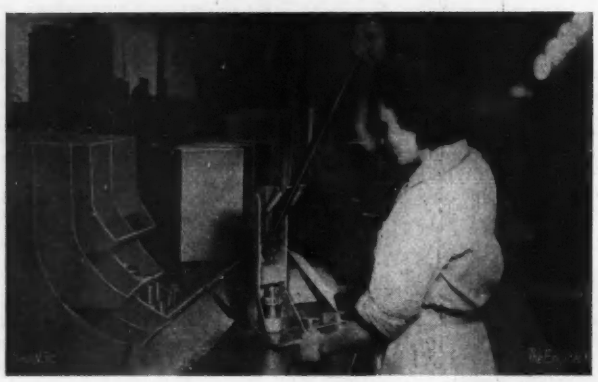
In the arrangement of the assembly benches a normal practice of specified places for everything has been generally followed.

Assembly Sequence

First Station.—Views reproduced herewith and on the opposite page illustrate the sequence of operations. At the first station the secondary piston is assembled into the cylinder. This stage entails handling nine components and carrying out a sub-assembly. To make the sub-assembly, two stops must be pressed into the piston body. For this operation a toggle press, with a suitable jig for giving the correct length, is conveniently mounted at the right-hand side of the station. The handle of the press is spring-loaded to return it to the "off" position after use. As each secondary piston is assembled it is passed down an inclined gauge, fixed to the bench, for checking the length.

Second Station.—The gasket and cover plate are assembled to the cylinder at this station. Here only four components are handled—

ASSEMBLY OF HYDRAULIC BRAKE MASTER CYLINDERS



FIRST STATION—PRESSING STOPS INTO PISTON BODY

SECOND STATION—PICKING UP SPRING WASHERS

THIRD STATION—TIGHTENING CYLINDER HEAD ASSEMBLY

FOURTH STATION—TIGHTENING OF SIDE HEAD INTO CYLINDER

FOURTH STATION—ATTACHING SPRING RETAINERS BY BENCH PLIERS

FIFTH STATION—INSERTING CIRCLIP

SIXTH STATION—CYLINDER IN HYDRAULIC TEST FIXTURE

SEVENTH STATION—TIGHTENING FILLER PLUGS ON INDEXING FIXTURE

gaskets, cover plates, spring washers and set-screws. For operating convenience the set-screws and washers are carried in containers mounted on the work bench. The spring washers are stored in a small trough at the front of the bench, which has a small extension at each end for holding a dowel pin. The containers for the set-screws are mounted at each side of the work fixture to allow two-handed working.

The cylinder as received from the first station is placed in a cradle fixture, and the two dowel pins are placed simultaneously in diagonally opposed holes, so that when the gasket and cover plate are placed over the holes there is exact hole location. An interesting method is used for putting the spring washer on each set-screw. The middle portion of the trough for the washers is filled with a Sorbo rubber pad on which a number of washers lie. To assemble a washer on to the set-screw it is merely necessary to insert the set-screw through the washer, press on the rubber pad, and grip the washer with finger and thumb. This method allows both hands to be used effectively, whereas usual methods would entail picking up a washer in one hand and the set-screw in the other to thread one on the other.

Mechanical stud runners are used for tightening the set-screws. The present design of master cylinder calls for the use of two stud runners. One is counterbalanced on a frame directly above the work cradle and the other is in a holder conveniently placed in relation to the operator's right hand. The latter is for tightening the cover set-screws and is a light pneumatic impact wrench with preset torque. With this tool there is said to be little or no torque reaction to be absorbed by the operator's arms.

Third Station.—For the assembly of the cylinder head to the cylinder eight components have to be handled and one sub-assembly made by closing a tapered return spring on a retaining cup. A small bench-pliers fixture is mounted on the bench for carrying out the sub-assembly. The various components are then placed in position and the cylinder head is screwed in for a few threads by hand. For tightening the head, the cylinder is placed in a jig and a special box spanner rotated by a hand-wheel is used to screw the head home. This spanner fixture also incorporates a rack and pawl mechanism which is pedal operated to complete tightening the head into the cylinder. The operator is able to use the full weight of body and there is much less effort than is entailed in using a conventional spanner, even with greater leverage. Incidentally, it may be remarked that this device is approved by specialists in industrial medicine.

Fourth Station.—For assembling the side head into the cylinder, the operations are similar to those carried out at the third station, and the equipment is exactly the same. This is the final station on this side of the double bench. Part-finished assemblies are placed in an inclined chute for transfer to the second assembly bench. It is only in lifting the cylinder from the chute that an operator has need to lift a cylinder more than an inch or two.

Fifth Station.—At this station the primary piston and circlip are assembled to the cylinder. The primary piston is first assembled by methods that duplicate those employed at the first station for the secondary piston, and the circlip is then inserted. To maintain a regular time cycle for inserting the circlip, a special fixture has been designed. Experience has shown that when hand pliers are used, which is the normal method, the cycle time may vary greatly, even with an experienced operator. Such variations would, of course, completely upset the rhythm that is so necessary for a planned system.

On the fixture now used, the circlip is mounted on a spring-loaded plunger with a specially shaped nose. This plunger is operated by a pedal, and forward movement carries the circlip into a position from which it springs into the circlip groove and clear of the plunger. Removal of the pressure from the pedal allows the plunger to return to the loading position.

Sixth Station.—Complete hydraulic tests are carried out on all Lockheed cylinders. The methods hitherto employed were searching, but lengthy. Four distinct tests have to be carried out, and in the original test sequence this entailed blanking-off certain orifices with screwed plugs and screwing air connections to others for one test, and then changing over for the other tests. The time taken to carry out these tests was altogether disproportionate to the time for the other assembly functions. Consequently, completely new testing methods have been devised, which are still as searching as before, but much quicker.

In the new testing sequence the cylinder is placed in a cradle and all tests are carried out without removing the cylinder from the fixture; the various connections, whether for blanking-off for air lines, are made by means of special couplings which are merely placed and not screwed into position; all the couplings and air lines are carried on frames for quick positioning; finally, and this is typical of the careful design, the operator lifts the testing fluid tank to the cylinder by turning a crank handle because it is less laborious to do it this way than it would be to lower the cylinder into the tank and then raise it. When the tests are completed, the cylinder is removed from the jig, the surplus fluid is emptied out, and the cylinder is placed on the draining tray.

Seventh Station.—At this, the final station, the cylinder is loaded on to an indexing fixture for assembly of the filler plugs and adaptors. This is the only station at which the various tools are not given fixed positions. At this station the push-rod and boot sub-assembly to go with the master cylinder are also assembled.

A Large Canadian Aluminium Plant

At Kingston, Ontario, in the Dominion of Canada, the plant erected by the Aluminum Company of Canada at the outbreak of the war and since materially extended now turns out 4,000,000 lb of aluminium a month, an increase of 1,000,000 lb over the record monthly production during the war years. The Kingston plant makes sheet, tubing, extrusions and structural steel shapes and is a link between the smelters at Arvida, Quebec and the more than 600 Canadian factories where the finishing of aluminium products of every description is effected.

The plant comprises three divisions, which together cover approximately 300 acres of ground. In the south plant rolling and extrusion operations are carried out. The north plant is set aside for forging, and there is a large testing and research division known as Aluminum Laboratories, Ltd. The total cost of buildings, equipment and stocks in storage is said to be about 20,000,000 dollars. During the war years as many as 3700 workers were employed.

Apart from certain melting processes, every operation in the Kingston plant is controlled electrically. Power is brought in from the Ontario Hydro-Electric Commission's sub-station at Frontenac, on the outskirts of Kingston, at 110,000V, and is stepped down in transformer banks to 2300V. This power is again stepped down in the plant to convenient operating voltages—for most purposes to 550V—and some of it is converted to direct current. Two 250-kW d.c. generators operate the cranes and motors.

The aluminium is shipped from the company's smelters to Kingston in 20-kg ingots. The ingots are melted in the twelve furnaces of the remelt department for the preparation of different alloys. Alloying copper, magnesium, nickel and sometimes iron and chromium are there added to the pure aluminium. New ingots of various shapes are cast by these furnaces for fabrication.

If the ingots are to be made into sheets they are sent on to the hot rolling mills. But first they are preheated in electric furnaces. There are forty of these furnaces in the Kingston plant, and, according to the number in operation at one time, they call for loads varying between 700kW and 1800kW. The mills roll the aluminium to plates ½in in thickness. In cold roughing mills the plates are rolled down to sheets, and in strip finishing mills these sheets, coming through at a speed of 600ft a minute, are still further reduced in thickness to meet exact specifications. There are flat sheet mills for a wide type of sheet and high surface polishers for imparting a finishing lustre. Electrically controlled devices coil the sheets as they come out of the mills and an apparatus known as a "flying shear" picks up the coils, trims them to the width wanted and cuts them to the desired length. Tubes, rods and shapes are fabricated by the extrusion process.

The forge plant at Kingston was especially built for wartime production. It houses a battery of more than a dozen hammers ranging from 2000 lb to 35,000 lb, and a number of hydraulic presses with a capacity varying from 80 to 2500 tons. As the demand for aluminium forgings, unlike the demand for sheet and extrusion products, has fallen off since the war, this section is much less active than the mill section.

Adjacent to the south plant is a building which houses the research division. It embodies in the lay-out the chief features of the first laboratory operated by Aluminum Laboratories, Ltd., and affiliates, at Banbury, England. The many scientists and technicians who work there have at their disposal modern equipment for systematic applied research.

In the month of August, 1947, the consumption of electricity at the Kingston plant reached 18,300 h.p. With an extension now being carried out by the company to meet new business, the demand for power seems likely to increase.

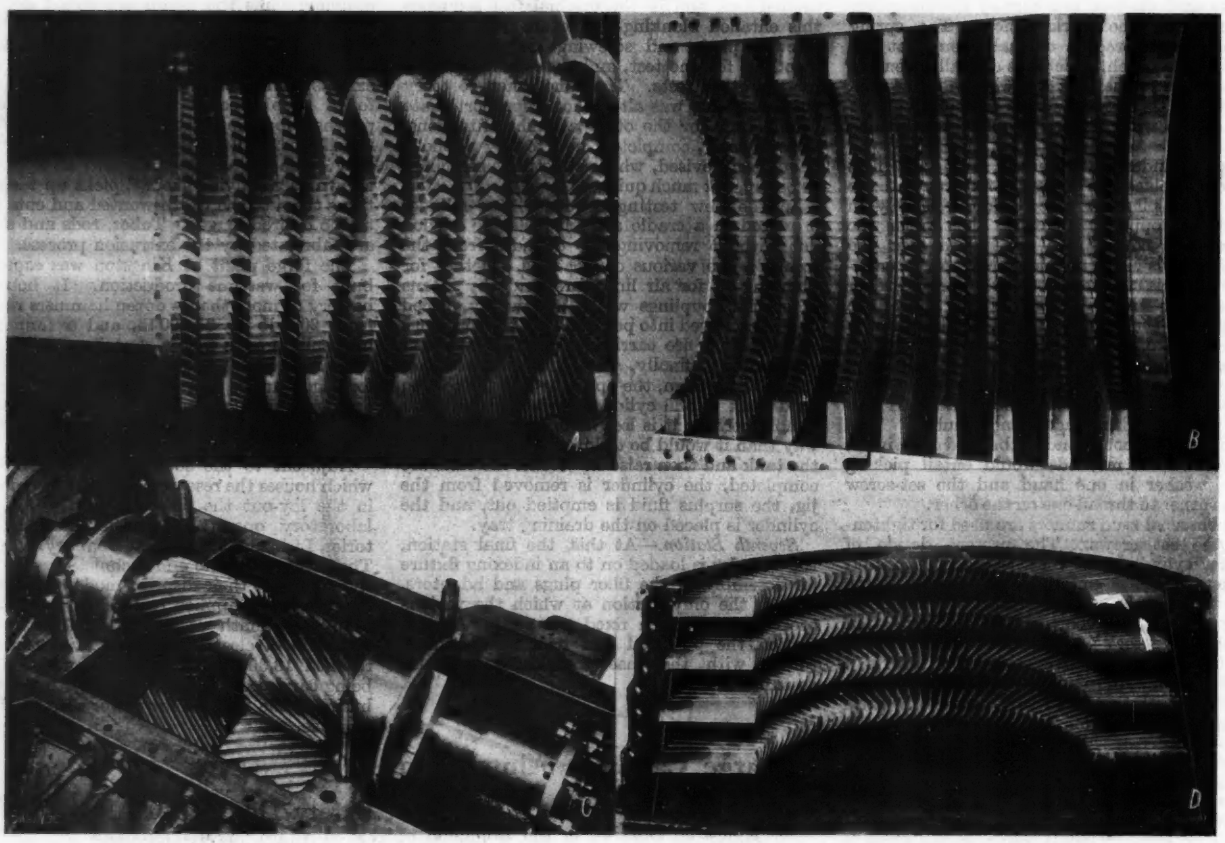
Safety Device for A.C. Welding Equipment

Most operators of a.c. transformer arc welding plant are familiar with the unpleasantness involved in changing electrodes or handling the electrode holder under adverse conditions when the open circuit voltage, which is usually about 80V, can be a source of danger unless adequate precautions are taken. One solution of this problem is to fit the transformer with a simple device which will automatically reduce the voltage to a safe value under all conditions, within a short interval of the breaking of the arc. In any such device, the fall in voltage should not be instantaneous since this would have an adverse effect on the welding performance of the set. Furthermore, the voltage should be available immediately for restriking the arc and the operation should be completely automatic so that there are no separate leads or controls requiring the welder's attention.

A simple piece of equipment, designed to meet these requirements and known as the Murex safety device for a.c. welding equipment, has been introduced by Murex Welding Processes, Ltd., Waltham Cross, Herts. This unit consists of a timed relay controlling an auxiliary circuit. The effect of breaking the arc at the end of a welding run is to actuate the relay which opens after a finite time delay of a fraction of a second and introduces the auxiliary circuit which has the effect of reducing the open circuit potential difference of 80V to 100V to about 30V. Welding is started again by touching the electrode to the work in the normal way. This action causes the auxiliary circuit to close the relay instantly. The full welding voltage and current becomes available immediately, so that the arc can be drawn and welding continued without calling for any change in the operator's technique.

The safety device is introduced into the secondary circuit of the transformer, between the output side of the self-contained transformer or choke and the electrode holder. The unit is compact and can be fitted to the tank of the self-contained arc welding transformer or to the reactance coil. Alternatively, the unit can be treated as a separate component in a portable form, or arranged for wall mounting.

2500-H.P. GAS TURBINE OF M.G.B. "2009"

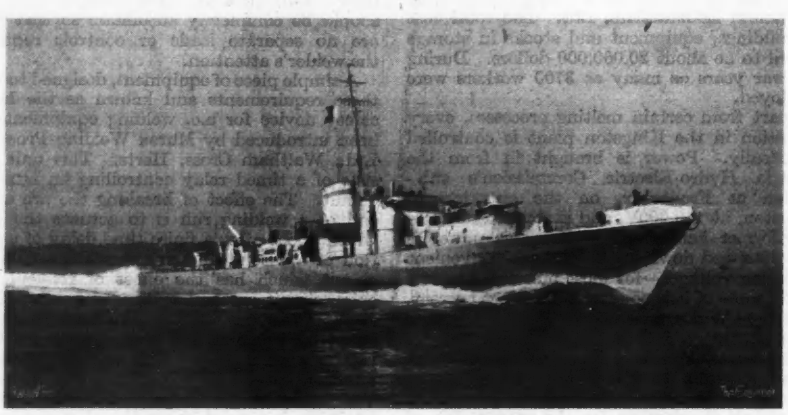


COMPRESSOR ROTOR
REDUCTION GEAR

HALF STATOR OF COMPRESSOR
HALF STATOR OF POWER TURBINE

Naval Development of the Gas Turbine

IN reviewing the progress made in the design and construction of prime movers in our issue of January 23rd we made reference to the work of the Metropolitan-Vickers Electrical Company, Ltd., in installing a 2500 h.p. gas turbine in the experimental naval craft "M.G.B. 2009," which went to sea on July 14, 1947.



H.M.S. "GREY GOOSE"

The installation was fully described and illustrated in three articles which appeared in our issues of September 5, 12 and 19th last year.

Last week we were invited to visit the gas turbine works of Metropolitan-Vickers at Trafford Park, Manchester, to see the gas turbine opened out in the builder's works for the inspection of Admiralty officers and visitors.

It was the original intention to run the turbine installation for about thirty hours during the official trials, and then to return it to the manufacturers works for inspection and overhaul prior to it being reinstalled for a second series of trials. The behaviour of the gas turbine at sea was, we learn, so satisfactory, that the original programme of trials was extended in order to include a considerable period of endurance running. When the extended programme had been fully completed, the plant had run for fifty-five hours. All the trials were carried out by the Admiralty, in collaboration with engineers of Metropolitan-Vickers.

We inspected the turbine parts laid out, and found them to be in good condition. Parts of the compressor and turbine are illustrated herewith.

The general condition of the blading of the air compressor, while very satisfactory, showed a minute deposit of salt on the compressor blades, This was not unexpected, as during the test some 3000 tons of salt-laden air had passed through the compressor and the turbine. More than half the deposit was in the nature of cotton

COMBUSTION CHAMBER

fluff, and a quarter was salt, the remainder being of a sandy nature.

In this connection the builders had previous experience of slight traces of salt on compressor blading, and found that by washing the compressor with water the salt was very easily dissolved,

and that the performance of the compressor could thus be maintained unimpaired. It will be recalled that the gas generator turbine drives the air compressor. The four-stage power turbine is not mechanically connected with the gas generator turbine, but drives the propeller through reduction gears. Both these turbines were in very good condition with little noticeable deposit on the blades. We noted, however, that in the case of some of the high-temperature blades, the original nickel plating had been burnt off.

The combustion chamber, of which we give, an illustration herewith, was quite satisfactory and accorded with the firm's previous experience with this design. The carbon deposit from the burners was light, and there was only a minor distortion of the primary combustion chamber which, it is claimed, has no important effect on performance. In the second turbine unit which is to be installed in "M.G.B. 2009" a combustion chamber of slightly modified and stronger design will be used, and a similar casing will eventually replace the present combustion chamber casing.

We examined the upstream fuel burners which are, it will be remembered, twenty in number, and are spaced circumferentially around the combustion chamber. Each is surrounded by a sheath through which a small quantity of cooling air from the secondary passages of the combustion chamber is passed. The burners appeared to be quite satisfactory.

The reduction gear, a view of which is reproduced herewith, was in good condition, and both the pinions and wheels showed excellent bedding over the working faces of both helixes. The self-synchronising clutch with its operating gear showed no signs of undue wear on the pawls and the clutch teeth. The Michel type thrust block was examined on both the ahead and astern faces and was found to be in good condition, as were all the roller bearings.

At a conference held at the Admiralty on Friday afternoon, January 30th, the Engineer-in-Chief, Vice-Admiral (E) D. C. Ford, C.B., stated that the general condition of the gas turbine installation augered well for the future of the gas turbine as a marine propulsion unit. He announced that the "M.G.B. 2009" is to be equipped with a slightly modified "Gatric" unit supplied by Metropolitan-Vickers Electrical Company, Ltd., and on completion she will start sea trials on the Solent. This unit will run continuously for many hundreds of hours, so as to ascertain its total useful life at sea.

The Admiralty is also planning larger gas turbine machinery for installation in an escort vessel, probably a frigate of the "Captain" type. The plant to be used for this particular project has been designed for marine propulsion service from the initial stage, and it is predicted that its durability and efficiency will be greater than those of the "Gatric" units mentioned above. The manufacturers will be the English Electric Company, Ltd.

Another naval project is the powering with gas turbine machinery of H.M.S. "Grey Goose," a gunboat of 250 tons, considerably larger than the "M.G.B. 2009." For this installation the contractors will be the Rolls-Royce Company, Ltd. An illustration of the "Grey Goose" is given herewith. She was built by John Samuel White and Co., Ltd., of East Cowes, and is equipped with lightweight steam machinery. She was the leader of a flotilla which, in the recent war, acquired a reputation as "E-Boat Killers." With their steel hulls, these vessels were regarded as miniature destroyers, but were officially classed as "light coastal force craft," and the enemy was left to believe that they were ordinary motor gunboats.

In conclusion, the Engineer-in-Chief expressed the view that the development we have outlined may form the start of a new era in marine propulsion, certainly as regards warships, in view of the important power-for-weight factor. Much money is being spent by the Admiralty on research in this connection. In time, it is hoped to use ordinary boiler fuel instead of diesel oil. Ultimately, it is thought, there seems to be no reason why a gas turbine-propelled naval vessel should not have a useful life of 100,000 hours at sea.

Sub-Miniature Valves for Hearing Aids

An interesting advance in British valve manufacturing technique is revealed in the announcement that the Ministry of Supply has placed an order with the Mullard Wireless Service Company, Ltd., involving 400,000 sub-miniature thermionic valves for use in the State-sponsored hearing aid known as "Medresco." Briefly, the "Medresco" unit is a small amplifier in a wedge-shaped case, which is 2¼in wide at the top, tapering to 1¼in at the bottom. Its overall length is 3¾in, and its thickness is 1in.

This compact case houses an amplifier using two of the new sub-miniature voltage-amplifying pentodes, DF 70, and either a DL 71 or DL 72 output pentode. It is claimed that these valves have a greatly reduced power consumption compared with the American types, CK 505 AX, CK 502 AX and CK 506 A, which they resemble in basic design. The Mullard valves referred to above are only 10mm (0·4in) in diameter, the DF 70 pentode is 30mm (1·16in long), while each of the output pentodes, DL 71 and DL 72, is 38mm (1·5in long).

The electrode structure is built up on a flat glass disc, in a manner basically similar to that employed in the well-known all-glass technique, which is used in this country by the Mullard laboratories. This method of construction ensures a high degree of rigidity and, consequently, freedom from microphony. The lead-out wires are tinned to facilitate soldered connection into the circuit.

Mullard Sub-Miniature Valves

Type	DF 70	DF 71	DF 72
V_f	0·625	1·25	1·25
I_f(mA)	25	25	25
V_a	30	45	45
V_{g2}	30	45	45
V_{g1}	0	−1·25	−4·5
I_a(mA)	0·375	0·6	1·25
I_{g2}(mA)	0·125	0·16	0·4
g_m(mA/V)	0·22	0·55	0·5
Power output (mW)	—	6	23
Gain	40 R_a = 1M R_g = 3M	—	—

Reference to the accompanying table will show that the filament current ratings of the Mullard sub-miniatures are extremely low. The improvement will be apparent when it is considered that the three-stage amplifier in the hearing aid consumes a total filament current of only 50mA, as compared with 75mA for a similar circuit employing American sub-miniatures. This represents a saving of over 30 per cent in current. Taking into consideration the high performance obtained with the Mullard sub-miniatures, the anode current ratings are also extremely low. The nominal anode voltage rating for the DF 70 is 30V, whilst the voltage rating for the DL 71 and DL 72 is 45V.

The DL 71 output pentode is intended for use with the hearing aid circuit designed to work with a crystal earpiece of the insert type, and delivers a power output of 6mW at a distortion level of not more than 10 per cent. An alternative circuit, incorporating the higher-powered output pentode DL 72, is available for use with an external magnetic type earpiece.

The choice of earpiece is governed by the particular needs of the deaf subject, but in either case the total power consumption of the hearing aid is extremely low. For example, the circuit for use with a crystal type earpiece normally consumes not more than $^1/_{10}$W, whilst the total power consumption of the circuit intended for use with a magnetic type earpiece is not greater than ¼W.

We learn that the "Medresco" aural aid is to be made available to all persons suffering from defective hearing and will be distributed through the Ministry of Health clinics when the National Health Service Act comes into operation on July 7, 1948. It is stated that 400,000 units are to be produced, together with 100,000 annual replacements and that the whole scheme will cost some £5,000,000 a year.

Direct Filling of Locomotive Sand-boxes

In order to eliminate the waste of time and labour involved in filling engine sand-boxes by the hand bucket method, the L.N.E.R. has introduced a system for the direct delivery of sand to the boxes from the drying plant at the March locomotive depot. In common practice, unless the buckets used for putting the sand in the boxes can be kept perfectly dry, there is a risk of filling them with damp material, which can lead to the ultimate failure of the locomotive sanding apparatus. There is often some difficulty in pouring sand from the bucket into the mouth of a sand-box and no little risk of the spillage of sand over the locomotive valve motion, axle-boxes and other vital parts. Difficulty is also experienced in replenishing the boxes of certain modern types of engines

FILLING A SAND BOX AT MARCH DEPOT

having their running plates over the coupled wheels, which necessitates the lifting of the full buckets of sand to a much higher level than in the case of older engine classes.

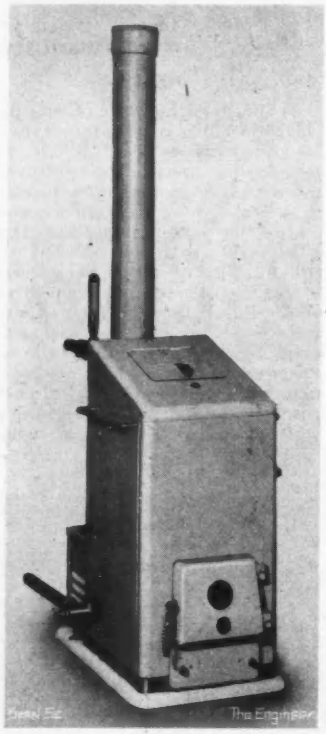
At the March depot sand is delivered direct from the storage bunkers to the engine sand-boxes through a flexible pipe. For this purpose a set of dry sand storage hoppers was raised about 3ft and the two original outlet pipes on each hopper were replaced by flexible hoses having a nozzle and a valve at their lower ends.

As can be seen from the photograph we reproduce, enginemen can now stand on the running plate of a locomotive and fill each sand-box with the minimum of effort and with some saving of time. There are two hoppers in the set, so that a pair of flexible pipes is available on each side of an engine. The pipes in each pair are unequal in length, and the enginemen can select the more suitable according to the height of the engine sand-boxes from the ground, a dimension which varies considerably among the various locomotive classes.

The British Council.—The annual report of the British Council, covering the year 1946–47, records that advice was given on questions concerning the technical education and post-university training in this country of ninety-three overseas students from thirty different countries. The subjects selected by the students ranged over about twenty branches of engineering and science. Advice and assistance were also given to private students and overseas engineers visiting this country. The report adds that the Council gave assistance in the selection of suitable British candidates for appointment as advisers and professors for China and countries of the Middle East.

A Fabricated Hot-Water Boiler

We have received particulars of an interesting all-steel, fabricated, automatic hot-water boiler for central heating and domestic supply which is now being made by Trianco, Ltd., Imber Court, East Molesey, Surrey. The design and construction of the boiler, which is specially intended for use with small graded anthracite "grains" or "peas," is shown in the photograph and drawing reproduced herewith.



HOT WATER BOILER

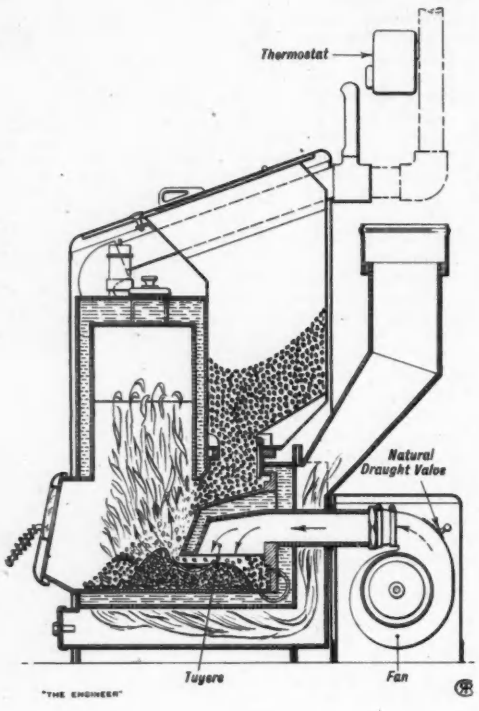


DIAGRAM OF BOILER

Sufficient fuel for a relatively long period, which naturally varies according to weather conditions or the speed at which hot water is drawn from the system, is stored in a hopper integral with and at the rear of the boiler. Fuel falls by gravity through a valve at the bottom of the hopper into the firebox below. As the fuel drops on to a flat plate forming the base of the firebox it builds up into a cone which completely covers and surrounds a water-jacketed tuyere situated immediately below the hopper mouth.

This tuyere is an integral part of the water-filled rear wall of the boiler, and through it combustion air is fed to the fuel bed by a motor-driven fan. Set in the fan duct is a valve through which a natural draught of air is admitted to maintain combustion at the mouth of the tuyere when only sufficient air is required to keep the fuel alight.

When hot water is withdrawn, or when there has been a fairly heavy heat loss in the system, the forced draught fan is automatically switched on by a thermostat in the outgoing flow pipe. As long as the water in the system remains at a predetermined temperature the fire is kept just alight and the fan remains idle. When the temperature drops, the forced draught comes into effect and is automatically cut out when the required temperature is again reached in the system. By this arrangement a considerable economy in fuel is obtained, while the consumption of electricity for operating the fan is negligible.

Water-filled baffles extending upwards from the firebox floor direct the hot gases up to the top of the boiler, where they are deflected downwards to pass between the baffles and the water jackets forming the outer walls of the boiler. At the bottom of the walls the gases pass below the firebox floor and out into the chimney. During their circuit round the boiler practically all the useful heat is extracted from the gases of combustion.

Cleaning of the firebox is quick and easy with this design of boiler. As the fuel burns away, the small amount of residue is fused by the high temperature into a single cone of clinker which is easily removed through a door in the front of the boiler. It is stated that at all times during the operation of the boiler, the suction of the chimney is sufficient to remove all the fumes of combustion.

The normal rating for hot water supply is 80,000 B.Th.U. per hour, and at this rating the fuel consumption is said to be approximately 7½ lb per hour, but on a normal rating for heat only at 50,000 B.Th.U. per hour the fuel consumption would be in the region of 4½ lb per hour; this is when under forced draught. When the fire is just burning and not under forced draught the fuel consumption falls as low as ¼ lb per hour, and the boiler can remain in this condition for ten or twelve hours.

The efficiency factor claimed for the boiler is 80 per cent on a normal heating and domestic load.

A Pneumatic Drill Jig

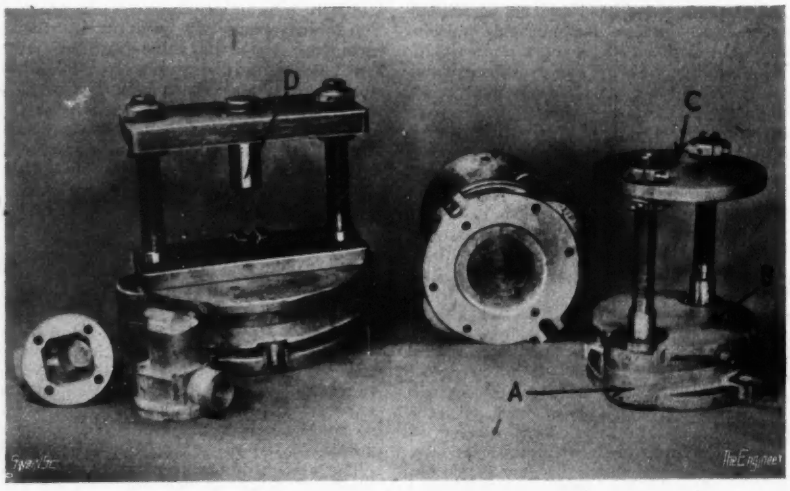
A useful little drill jig made by A. Bullow and Sons, Ltd., which incorporates quick action pneumatic clamping means, is now being distributed by E. H. Jones (Machine Tools) Ltd., Edgware Road, The Hyde, London, N.W.9. It is designed as a standard fixture which can be adapted to accommodate various components for drilling and tapping, and it has interchangeable drill and location plates which can be quickly and easily fitted.

The component parts of one of these jigs can be seen in the illustration below. The jig has a cast aluminium base A, which encloses a short stroke air cylinder in its under side. Extending upwards through the base, and sliding in hardened and ground steel bushes, are two vertical pillars which are actuated by the air cylinder. Seated on the projecting necks of the pillar bushes in the base is a locating plate B. A drill plate C is carried on the two pillars and it sheight, in relation to the locating plate, is adjusted by means of nuts on a truncated coarse thread on the pillars. The nuts are split for locking purposes, and a spring washer is fitted under the drill plate to prevent binding.

In operation, the pillars are pulled downwards by the air cylinder in the base, clamping the component between the drill plate and the locating plate. The cylinder is of the free edge diaphragm type, and imparts a limited movement of ¼in to the drill plate. The limitation of travel makes it necessary to provide swing out drill plates or retractable locations on work of certain shapes. The jig shown on the left of the illustration is an example of a retractable means of location. The spigot D in the drill plate locates the bore of the component and is lifted out when inserting or removing work from the jig.

For these jigs, the drilling and locating plates are made from stock blanks, which are supplied with the holes already bored for the pillars and pillar bushes. A ¼in diameter hole in the centre of the drill plate, on the centre line between the pillar holes, provides a datum to facilitate setting up when jig boring new plates.

The valve controlling the air supply for clamping purposes can be arranged for either hand or foot operation.



PNEUMATIC DRILL JIG

Continental Engineering News

A Radio Tower at Stockholm

A concrete tower claimed to be the highest in Europe was recently built in Sweden for the Telfonaktiebolaget L.M. Ericsson (L.M.E.). The tower, 236ft high, is intended for research in the transmission of short waves ranging from 10m to 1cm. The structure, measuring 16ft by 19ft, was erected by teams of three men working continuously in three eight-hour shifts for three weeks. Sliding shuttering was used and a considerable saving of timber and labour was recorded. The uppermost rooms in the tower will contain a laboratory equipped for research in micro-wave technique. The dispersion of these radio waves is as yet only partially explored, and a great deal of work will therefore have to be done in Sweden, as elsewhere, to develop this field of radio technique, especially in view of Sweden's peculiar climatic conditions. The tower is also eminently suitable for television transmission and frequency-modulated radio, which is specially used for telephone communication with motor cars. The tower was designed and constructed to fit in with an eight-storey laboratory and office building. The structure was erected by the A.B. Skanska Cementgjuteriet.

Reconstruction of Italian Sea Harbours

According to a paper presented by Professor Luigi Greco, at a Transport Congress held recently in Italy, damage suffered by Italian sea harbours consequent upon air bombing, naval bombardment and German destructions, may be summarised as follows :—

Provinces	Piers	Wharves	Port equipment	Dry docks	Buildings (hangars, silos, &c.)		Beach protection
					Destroyed	Damaged	
	Yards	Yards	Number	Number	Number	Number	Yards
Liguria	4,500	10,800	264	3	31	90	2,750
Tuscany	2,700	4,400	30	—	4	12	3,300
Latium	1,300	6,700	14	—	12	8	350
Campagna ...	1,100	7,600	72	1	15	48	—
Calabria ...	220	620	3	—	6	8	2,200
Apulia	6,000	2,400	5	—	—	5	—
Abbruzzi and Molise	1,640	1,400	—	—	4	3	—
Marches	1,300	3,400	18	—	17	11	—
Emilia	1,800	5,800	10	—	9	16	6,600
Veneto	800	1,500	64	—	8	38	5,500
Sardinia	70	2,400	18	—	7	11	880
Sicily	1,040	9,100	39	1	18	32	—
Total	22,470	56,120	537	5	131	282	21,580

Amongst Italian sea ports, the harbours of Naples and Genoa particularly suffered from war. After the liberation of the country, Italian authorities prepared a comprehensive scheme dealing with harbour reconstruction and extending over five years. This scheme contained provision for the expenditure of 2,000,000,000 lire for the period 1945–46; 5,000,000,000 lire for 1946–47; 5,000,000,000 lire for 1947–48, and 4,000,000,000 lire for the period 1948–49. There is a special provision for the rehabilitation of the sea harbour at Naples and Genoa, where dry docks are being built. The total figure for the five-year plan of rebuilding Italian sea ports amounts thus to 22,000,000,000 lire. Works representing a sum of 3,615,000,000 lire have been already completed, while works with a total cost of 7,241,000,000 lire are in progress. It is hoped that all Italian sea harbours will be rebuilt by the end of 1948, one year in advance of official estimates.

Mont Blanc Tunnel

The old scheme of a tunnel through Mont Blanc, linking Burgundy and French Switzerland with Piedmont and Lombardy, is now being put into effect. Driving works, on the Italian side, started in May, 1946. By the end of 1947, tunnelling had progressed 1650ft.

As soon as the necessary equipment, ordered abroad, arrives, 2000 more workers will be engaged, increasing considerably the progress of works. At the French end, works have not yet started, but a beginning is expected to be made shortly in the vicinity of Chamonix.

The Mont Blanc tunnel, about 6 miles long, will be driven in a straight line. One portal will be situated above Chamonix, near the Dard Falls, while the other will be at the foot of Mont Frety, in the Aosta Vale. Traffic in in the tunnel is estimated to be 100,000 vehicles and 200,000 pedestrians yearly.

It is intended later to add a railway track. The tunnel consists of a single gallery, 24ft 10in wide and 17ft high. In addition, there is also a central drift, 6½ft by 6½ft, for electric wires and ventilation ducts. A part of the electrical energy produced by twenty-two hydro-electric plants, which will be built in the area of Grand Paradisio (Aosta Vale), will be transmitted by cable through the tunnel to augment French supplies in summer. In return, French thermal plants will export in winter electric energy to Italy.

A Timber Railway Bridge in Germany

A notable timber bridge was recently completed on the railway line between Karlsruhe and Heilbronn. Replacing a steel structure destroyed during the war, the new bridge, with its span of nearly 100ft, is one of the longest timber railway bridges in Europe. The heavy loading for which the bridge is designed precluded any possibility of building an orthodox timber bridge. Engineers of the Reichsbahn selected, therefore, a lattice girder structure, inspired by steel bridges of similar type.

A single-track decking is carried on three main lattice girders, 13ft high, held together with nails. These girders, spaced at 3ft 3in centres, are provided with suitable wind bracing, and a very stiff structure has resulted. Planks, 10in wide and 2in thick, were used for the main girders. Timber was stressed at 1200 lb per square inch. Each girder weighed about 16 tons. The quantities of materials used on the contract were as follows:—Timber, 135 cubic yards; nails, 6600 lb (representing 110,000 nails); steel anchorage and bearing blocks, 7500 lb. Prior to its opening to traffic, the bridge was subjected to a test load. Movable loads were represented by two goods locomotives, weighing 170 tons each. This test produced an elastic deflection of 20mm and a permanent deflection of 3mm. As regards the braking effect, at a speed of 30 m.p.h. a lateral movement of only 1mm to 2mm was recorded.

Electric Energy in Spain

Unidad Electrica gives interesting details on the thirteenth year of the Spanish plan for the development of hydro-electric stations, destined to increase and improve the supply of electric energy in the country. According to this scheme, the capacity of power stations, by the end of 1953, will amount to 2,124,192kW; this figure represents more than twice the capacity available in 1939. The scheme contains provisions for the construction or extension of 107 power stations in the period 1940–53. Its whole cost is estimated at nearly 7000 million pesetas (about £160 millions), of which about 50 per cent are already spent. For the execution of the plan the country was divided into six zones, namely, Catalonia, Centre-Eastern zone, Centre-Northern zone, North-Eastern zone, Aragon and Andalusia. Among large dams now under erection, the Alarcon dam will be one of the outstanding hydro-electric works in Spain. Situated on the River Jucar, in the province of Cuenca, the Alarcon dam will provide a reservoir with a capacity of 25,000 million cubic feet, intended for the irrigation of a plain of 100,000 acres and the operation of hydro-electric stations. The reservoir will form a basin, which will provide a mean annual discharge of about 18,000 million cubic feet. The total volume of concrete to be placed in the Alarcon dam is about 320,000 cubic yards, its height being 275ft.

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, *Victoria Street, London, S.W.*1.

COPPER AND BRASS TUBES FOR GAS INSTALLATION WORK AND GAS LIGHTING FITTINGS

No. 1401/3 : 1947. These new standards for solid-drawn copper and brass tubes are based on B.S. 659, B.S. 885 and B.S. 886, which have been adapted and amended to suit the special requirements of the gas industry. B.S. 1401 is for copper tubes, plain or screwed, as may be required, for installation work and also for gas lighting fittings. B.S. 1402 is for annealed brass tubes for installation work normally screwed. B.S. 1403 is for brass tubes for gas lighting fittings normally screwed. These tubes are intended for the manufacture of pendants, brackets and other lighting fittings and are somewhat stiffer than for installation work. Tubing of the kind for installation work has to withstand bending and manipulation at site. For special purposes where maximum flexibility is required, as, for example, in bent connections to meters, fully annealed copper tubing is advised in the foreword. Each standard includes tolerances as to size and prescribes tests. In the case of B.S. 1403 a mercurous nitrate test is specified. Price 2s. post free.

WROUGHT STEELS (EN. SERIES)

No. 970 : 1947. This schedule of steels (called the En. Series) was first prepared as a war emergency specification to provide a co-ordinated and comprehensive series of steels for general engineering purposes, but it has proved so useful and has become so generally recognised that its continuation has been requested by users generally. The schedule has accordingly been revised and amplified so as to cover the needs of the general engineering industry, including the automobile industry. It provides for some ninety wrought carbon and alloy steels in tensile strengths from 28 up to 100 tons per square inch. The first section on general clauses includes heat treatment and general definitions, details of the provision of test specimens, methods of test, and requirements with regard to inspection, testing facilities and retests. For each steel the chemical composition, condition of material on delivery, heat treatment and the mechanical properties obtained from the test pieces are specified. As a comprehensive schedule of the steels used throughout the general engineering industries, this British Standard should be invaluable, and it is hoped that all users of steel will take full advantage of its publication. Price 10s. 6d., post free.

FLAMEPROOF MINING PLUG-AND-SOCKET

No. 279. The first edition of this standard for a 100 ampère flameproof mining plug-and-socket was published in 1927. The specification gave essential details for the design of plugs and sockets for connecting flexible cables to coal-cutting machines and coal-face conveyors, and some limitations in dimensions were embodied in order to ensure applicability to existing types of mining machinery. This had the effect of limiting the size of flexible cable that could be accommodated in the plug. When the second edition of the specification was issued in 1932, a maximum diameter for the cable gland was specified, and it was required that means should be included for connecting the screen of a flexible cable to the earthing terminal in the plug. Since then there has been a growing tendency to use the more complex types of cable and accordingly, in this present revision, alternative diameters of cable glands are specified in order to cater for the use of larger diameter cables. The specification was never intended to secure identity of component parts and in this revision the use of "contact-tubes" of non-cylindrical form is permitted provided this is compatible with interchangeability. Price 2s. 6d., post free.

Industrial and Labour Notes

Report of the Chief Inspector of Factories

The annual report of H.M. Chief Inspector of Factories, covering the year 1946, has now been presented to Parliament by the Minister of Labour, and was published by H.M. Stationery Office at the end of last week. The report is the first to be submitted by Mr. G. P. Barnett, who was appointed Chief Inspector of Factories a year ago in succession to the late Mr. H. E. Chasteney.

In a reference to the national call for increased production, the report observes that, during the year reviewed, attention was focussed probably to a greater extent than ever before on the human factors in industry. Welfare in its widest sense and the establishment of good personal relationships have now come to be recognised, the Chief Inspector says, as of the utmost importance as incentives to increased production. At the same time, the report deplores the existence of factories housed in old and unsatisfactory premises, and comments that there is evidence that in some areas, owing to post-war conditions, the occupation of slum property or at least of unsuitable premises for manufacturing purposes is increasing. It appears that a contributory factor is the high rents now charged for any accommodation.

Dealing with accidents, the report records that the number reported in 1946, under the Factories Act, 1937, was 223,759. Of this total, 826 were fatal accidents—3 per cent less than in 1945—and 222,933 were not fatal, a decrease of 7 per cent on 1945. A feature of the returns is the number of accidents occurring to demobilised service men, and the report gives two main reasons. The first is that, during their period of service in the forces, many men seemed to lose some of their skill, especially at operating machines; and secondly, having lived dangerously for several years, they were prone to take unecessary risks and show a certain contempt for safe practices. Emphasis is given in this section of the report to the need for well-organised resettlement training. The development of accident prevention schemes by individual firms or groups of firms is recorded and mention is made of the effective safety work done by joint production committees or works councils. The genuine desire which is being shown by employers to ensure much higher standards of cleanliness in factories is commended in the report, mention also being made of progress in connection with both natural and artificial lighting. The headway being made with colour schemes for interior decorations is another matter which is favourably commented upon.

Another section of the report is concerned with hours of work. It says that the most notable features of 1946 were the general reduction in the weekly hours of work in a variety of industries, and by the continued elimination of emergency permits, a return to normal statutory limits. There is no doubt, the report continues, as to the popularity among married women of the five-day week, and factories report that its introduction has reduced absenteeism and lateness, while the saving of fuel has been a particularly important factor. The report admits, however, that little reliable information is available about the effects of the five-day week on output; some factories express the view that output per hour is increased by its introduction, but others say that for the first few weeks of five-days, output is equivalent to that of the longer week and then declines until the hourly rate reaches its original level.

Coal Production Costs

Reference was made on this page of our issue of January 16th to the statistical statement, published by the National Coal Board, on the costs of coal production, proceeds and profits of collieries in Great Britain in the first and second quarters of 1947. The Board has now issued a similar statement in respect of the third quarter of last year, which shows that there was a loss of 2s. 6½d. per ton of saleable coal, compared with a loss of 1s. 7½d. in the second quarter and a profit of about 10d. per ton in the first quarter. The total cost of producing 39,294,911 tons of "commercially disposable" coal in the third quarter of 1947 was £91,649,879, and as the proceeds of sale amounted to £86,207,274, the loss, before charging interest, was £5,442,605. The earnings per manshift worked by underground workers in the quarter averaged 32s. 3d., and the average weekly earnings of underground workers, including allowances in kind, were 138s. 10d.

The main reasons for the loss in the third quarter are stated by the National Coal Board to be the introduction of the five-day week at the beginning of May, 1947, the extra costs of which were not covered until September 1st, when the pit-head price of coal was increased by four shillings a ton; and the effect of holidays, the tonnage lost from this cause being 4,500,000 tons compared with 2,500,000 tons in the second quarter. It is pointed out that because of annual holidays, the coal industry's production costs per ton are always higher in the third quarter of the year than in the second quarter.

The T.U.C. General Council

At its monthly meeting on Wednesday of last week, the General Council of the Trades Union Congress considered difficulties which have arisen in arranging for a meeting of the Executive Bureau of the World Federation of Trade Unions at which the subject of American aid to Europe would be considered. The T.U.C. feels that time is a most important factor in any attempt to assist in European recovery, and says that if a meeting of the W.F.T.U. Executive Bureau is not held this month, the General Council will consider itself free to participate in, or to take the initiative in arranging such meetings as may be necessary to consult with the other trade union national centres directly concerned in the question of American aid to Europe in its fullest implications.

Another matter discussed at last week's meeting of the T.U.C. General Council was the necessity of establishing throughout industry the maximum number of joint production committees. It was agreed to ask affiliated organisations to allow their district officers in appropriate cases to facilitate negotiations for the formation of these committees where no national agreement on the question exists, and where the local trade union membership desires a joint production committee to be formed.

Colliery Winding Enginemen's Dispute

It will be recalled that on January 13th the Minister of Labour appointed a Court of Inquiry, under the chairmanship of Sir John Forster, K.C., to investigate a dispute which had arisen between the National Coal Board and the National Union of Colliery Winding Enginemen. The dispute related to a claim for recognition of the National Union of Colliery Winding Enginemen as an organisation to negotiate for winding enginemen, and also to a claim for a general increase in wages for winding enginemen throughout all divisions.

The Court of Inquiry has now presented its report and says that the dispute is in fact purely one of recognition, having arisen because of the dissatisfaction of a section of winding enginemen with the existing machinery for negotiating terms and conditions of employment. While sympathising with the underlying motives of the winding enginemen, however, the Court says that it cannot agree that it would be in the interests of the colliery industry as a whole, or indeed of winding enginemen as one section of a class in the industry, that an organisation representing a section of them should be recognised as a separate entity outside the existing conciliation machinery for the purpose of negotiating conditions of employment. The Court considers that such an arrangement would not be in the interests of orderly relations between the National Coal Board and its employees, more particularly in view of the effect which its institution might have on other sections of the industry.

Finally, the Court of Inquiry feels that it is imperative that, within the existing organisation of craft groups in the National Union of Mineworkers, means should be devised to ensure that whenever questions affecting the rates and conditions of employment of winding enginemen are to be the subject of negotiations with the National Coal Board, at either district or national level, union representatives should include persons regarded by the winding enginemen themselves as competent to present their special interests.

Joint Conciliation in the Electricity Industry

Discussions have taken place recently for the purpose of agreeing joint conciliation machinery to operate in the electricity supply industry after the vesting date. Representatives of the British Electricity Authority have had meetings with the trade unions which are party to the machinery of the National Joint Industrial Council for Electricity Supply, with the Electrical Power Engineers' Association, representing the trade union side of the National Joint Board, and with the unions representing clerical and administrative grades in the employment of the supply undertakings.

An official statement says that progress was made in the discussions which have now been adjourned to enable the union representatives to consult their executives and for the British Electricity Authority representatives to report on the matter to the Central Authority.

Trade Disputes

The latest issue of the *Ministry of Labour Gazette* records that in December, 1947, there were reported to the Ministry 119 stoppages of work through disputes. In addition, sixteen stoppages which began before December were still in progress in the early part of that month. In these 135 stoppages 24,600 workers were involved directly and indirectly during December at the establishments where they occurred, and the aggregate number of working days lost was 79,000. In the preceding month, 162 stoppages were reported, involving 42,200 people and causing an aggregate loss of 176,000 working days.

In the whole of 1947, the number of stoppages of work owing to disputes reported to the Ministry of Labour was 1717, compared with 2205 in 1946. In all the stoppages in progress in 1947, there were 621,700 workers involved, and the aggregate number of working days lost was 2,432,000. In 1946, there were 529,500 people involved in the stoppages which occurred, and 2,158,000 working days were lost. Of the stoppages which took place last year, 1049 were in the coal mining industry, involving 307,500 workers, and causing a loss of 912,000 working days. In the engineering industry, there were 79 stoppages of work reported, and in them 27,500 people were involved with a resultant loss of 211,000 working days. The shipbuilding industry accounted for 114 stoppages, involving 67,300 workers with a loss of 324,000 working days; and in the iron, steel and other metal trades there were 98 stoppages which affected 16,000 workers and caused a loss of 44,000 working days.

Zinc Prices

The Minister of Supply has made the Control of Non-Ferrous Metals (No. 31) (Copper, Lead and Zinc) Order, 1948, which came into force on January 30th. This Order increases the maximum prices of zinc and zinc sheets by £5 a ton and of zinc oxide by £4 5s. a ton. The increases in price follow the recent rise in the American market price which affects the Ministry's buying prices for overseas supplies of zinc metal.

The Directorate of Non-Ferrous Metals has now resumed the granting of licences for the acquisition of unwrought zinc.

French Engineering News

(From our French Correspondent)

Prospects for the production of coal in France, viewed at the beginning of the year, would seem to be better for 1948 than they seemed to be at the beginning of 1947. The year 1947 was definitely bad for the French mines, but not entirely for reasons which had been expected. It was possible to retain many of the German prisoners who were to be liberated, three-fifths of them staying voluntarily. On the contrary, it was mainly due to failures of the French themselves, strikes, absenteeism and prolongation of annual holidays, which produced the poor results. Compared with 1946, the mines lost over 2,000,000 tons of coal, and 7,000,000 tons compared with official estimates which had taken into consideration modernisation, mechanisation, reorganisation and improvement in workers' conditions to boost production.

Prospects for 1948 are better because the favourable elements considered in 1947 will be maintained and even increased with new machinery and modernisation, while there is no grave deficit in manpower to be feared. There will be 16,000 more miners and 18,500 fewer prisoners. Many prisoners will become free workers shortly. The mines are seeking to reduce the average age of miners by encouraging older miners to retire as younger men enter the mines. In fact, it is thought that the tonnage fixed by the Monnet Plan for 1948, 58,700,000 tons, may well be achieved.

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The damage caused by the recent floods in Eastern France are greater than had first been shown. The rapidity of the flooding and lack of co-ordination of services made it impossible for industries bordering on the rivers to take the precautions necessary to limit the damage. Destruction and damage to raw materials and finished products was limited, but machinery, tools, electric installations and buildings suffered from prolonged flooding.

* * *

In the course of 1947, French coal imports amounted to 16,515,420 tons. In 1946 and 1938, imports were 10,395,498 tons and 22,808,000 tons respectively. The present year, 1948, is expected to be notable for the resumption of coal exports from Britain. French production for 1947 amounted to 47,300,000 tons of coal, compared with 49,300,000 tons in 1946, the difference being due to the strikes in November and December, 1947. Coal allocations to France for January, 1948, are estimated at 1,609,700 tons. In February, 1948, France will receive 1,503,000 tons of American coal. Following an agreement reached between the British, American and French Governments, the Saar's coal is to be integrated into the French economy. Until now, the Saar contributed 40 per cent of its coal to the European Coal Committee, and this amount will be progressively withdrawn, and other nations will depend on the growing Ruhr production. France, which now is allocated about 23 per cent of Germany's exported coal, will receive a proportionately smaller share. Within 15 months, the total Saar production of about 12,000,000 tons a year will be at France's disposal. France also has a tacit agreement with both Britain and the United States on a plan to exchange a certain amount of Saar coal against Ruhr coal, which is better suited for coke processing for the metallurgical industry.

* * *

Prices, particularly for steel products, have undergone a considerable rise compared with prices prevailing last November. In the steel industry there has been the double repercussion of the withdrawal of subsidies on coke and on the steel production itself. Other causes include transport increases and higher salaries. The increase is specially marked for high-quality sheet steel goods. Thus, while the basic increase is 123 per cent, that for certain special sheet steel goods is 150 per cent.

Notes and Memoranda

Rail and Road

BRITISH ROAD FEDERATION.—A pamphlet entitled "What is the B.R.F.?" has just been published by the British Road Federation, of 4A, Bloomsbury Square, W.C.1. In it are described the aims and work of the Federation, of which the principal one is to secure a properly planned highway system. A strong plea is made for a modernised road system, which, in the opinion of the Federation, will in the long run save the country many millions of pounds a year in time, wastage and accidents.

GLAZING FOR VEHICLES.—A new type of glazing for buses which allows quick replacement of windows is now being used by Leyland Motors, Ltd., on double-deck passenger bodies. Apart from the saving in the time of fitting windows, the glazing is claimed to have many other advantages. The glasses of deep sliding windows can be fitted flush with the exterior body panels, eliminating the need of a window pan. Even when a half-drop window is fitted, the comparatively shallow pan is devoid of any external ledge where moisture can collect and start corrosion. This flush-fitting glazing also simplifies the trim in the exterior of the bus and assists cleaning and maintenance. Rubber is used in the form of a moulded strip, which has three grooves or slots running along its length. One slot fits around the periphery of the window opening, another slot carries the glass window pane, whilst the third slot receives a separate locking strip of rubber, which, when wedged into position, locks the glass firmly in the window opening. To remove the window the locking strip is pulled out of its groove by any pointed tool and the window is then free to be taken out.

Air and Water

SAFETY AT SEA AND IN THE AIR.—In accordance with a resolution adopted by the Economic and Social Council of the United Nations, the United Kingdom Government has convened a committee of experts in aviation, shipping, telecommunications and meteorology, to consider special arrangements necessary for the co-ordination of their activities in connection with safety of life at sea and in the air. Meetings of the committee began at the offices of the Ministry of Transport in London on January 27th, and it was expected that they would conclude to-day. The meetings are being held in private under the chairmanship of Air Vice-Marshal Sir Conrad Collier, Chief of Technical and Operational Services, Ministry of Civil Aviation.

FOUR-BLADED PROPELLER TRIALS ON A LIGHT AIRCRAFT.—A series of interesting trials has been completed to gain performance information concerning the fitting of a four-bladed propeller to a light aircraft. The trials were made by the flight development section of the Fairey Aviation Company, Ltd., at the company's aerodrome at White Waltham, and were originally planned to study propeller noise cause, effect and means of reduction. A four-bladed light propeller was made by bolting together two standard Fairey two-bladed metal, fixed-pitch propellers. This composite propeller was fitted to a standard "Magister" aircraft. It was found that noise reduction was so slight as to be negligible; but the normal rate of take-off climb of 800ft/min. was increased to 1400 ft/min. Likewise, take-off run was considerably improved. Maximum and cruising speeds were not affected.

WILMINGTON PUMPING STATION, M.W.B.—The latest report of the Works and Stores Committee of the Metropolitan Water Board says that at the Wilmington, Kent, pumping station the pumping machinery, comprising two compound steam engines driving well and force pumps installed in 1888 and 1895, is in need of extensive overhaul, and the three Lancashire and two Cornish boilers installed between 1894 and 1901 are approaching the end of their useful life. A scheme for the complete remodelling of the station is to be submitted in due course, but meanwhile it is essential that the steam machinery be replaced. It is proposed, as an interim measure, to install in each of the two wells a two-stage electrically-driven submersible centrifugal pump, and in the existing engine house two three-stage pumps of similar type, arranged for surface working as force pumps for delivering the water through a Venturi meter into the Eltham zone. Pumps already in the Board's possession can be suitably adapted for the purpose, although in the case of the two submersible pumps now proposed to be utilised for surface working as force pumps it is intended that they should be replaced with surface pumps as early as possible. A supply of electric power is available from the local electric supply company on reasonable terms. Two of the Buckeye diesel engines purchased by the Board in 1946, together with two alternators and switchboards, would be erected as a standby and for peak load relief purposes. Water treatment now in operation at the station involves chlorination in the wells and dechlorination at the surface. The use of centrifugal pumps in the wells will reduce the contact period of the chlorine, and as a temporary expedient, until such time as a permanent contact tank can be constructed and brought into use, it is proposed to introduce between the well pump delivery and the force pump suction a length of some 200 yds of 30in main to increase the contact period. The existing chlorinating and dechlorinating apparatus will suffice under the new conditions.

Miscellanea

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD.—In our Civil Engineering Review, on page 59 of our issue of January 16th, we referred to the work of the North of Scotland Hydro-Electric Board. The sentence appeared: "A development scheme prepared by the Board in 1944 estimated that the Highland district is capable of producing an annual output of about 6,300,000kWh, in addition to 1,500,000kWh already developed." The first - mentioned figure should have read 6,300,000,000kWh.

INTERNATIONAL CONFERENCE ON LARGE ELECTRIC SYSTEMS (C.I.G.R.E.)—1948 CONFERENCE.—The C.I.G.R.E. Conference, 1948, will be held in Paris, and will open on Thursday, June 24th, and close on Saturday, July 3rd. Matters appertaining to the British delegation to the conference are dealt with by the British National Committee, under the chairmanship of Mr. P. V. Hunter, C.B.E., with the E.R.A. acting as Secretariat. The official languages of the conference will be English and French, to the exclusion of all others. The provisional list of papers will be given in Bulletin No. 1, copies of which will be issued shortly. Owing to the difficulties of accommodation, &c., intending delegates are requested to communicate with Mr. R. A. McMahon, Secretary, British National Committee, C.I.G.R.E., "Thorncroft Manor," Dorking Road, Leatherhead, as early as possible.

INTERNATIONAL CONGRESS OF APPLIED MECHANICS.—The seventh International Congress of Applied Mechanics is to be held at the Imperial College of Science and Technology, South Kensington, London, from September 5th to 11th, 1948. The technical sessions will be organised under the following sections: elasticity and plasticity; aerodynamics, hydrodynamics, meteorology; thermodynamics, heat transfer, &c., and vibrations, lubrication and experimental methods. In addition, as many as ten general lectures or surveys are contemplated on subjects likely to be of interest to members. Arrangements have been made for visits to the National Physical Laboratory, the Royal Aircraft Establishment, the National Gas Turbine Establishment, and the G.E.C. Research Laboratories, during the week following the Congress. Forms of application for membership and other material concerning the Congress can be obtained from the Organising Secretary, Seventh International Congress of Applied Mechanics, Imperial College of Science and Technology, London, S.W.7.

INDUSTRIAL MEASURING AND CONTROL APPARATUS.—At the recent annual general meeting of the British Industrial Measuring and Control Apparatus Manufacturers' Association, the chairman, Mr. W. G. Ardley, said that the status of the Association was higher now than it had ever been, and its contacts with various Government Departments, as well as with the British Iron and Steel Research Association, the British Standards Institution and the principal user industries had been strengthened. He thought that the importance of industrial instrumentation and the vital part it had to play in the industrial recovery of the country was now fully recognised on all sides. Continuing, Mr. Ardley said that to speed industrial recovery, efficient steps had to be taken to reduce waste and to economise in material, and in these respects, including the speeding up of production generally, the industrial instrument industry had a great contribution to make. The extended use and application of measuring and controlling equipment in industry could do much to ensure maximum efficiency in industrial processes.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

Wednesday, Feb. 11th.—BIRMINGHAM BRANCH: Chamber of Commerce, New Street, Birmingham. "Police Radio," G. Brown. 6.30 p.m.—BRADFORD BRANCH: Midland Hotel, Bradford. "Refrigeration," L. L. Emmett. 7.30 p.m.

Saturday, Feb. 14th.—ST. ALBANS BRANCH: The Peahen Hotel, London Road, St. Albans. "Refrigeration as Applied to Industry," W. Boag. 3 p.m.

Bradford Engineering Society

Monday, Feb. 16th.—Technical College, Bradford. "History and Development in the Making of Steel Wire," R. S. Brown. 7.15 p.m.

Hull Chemical and Engineering Society

Tuesday, Feb. 10th.—Church Institute, Albion Street, Hull. "The Relationship of Science to Salesmanship," W. M. McNicol. 7.30 p.m.

Illuminating Engineering Society

Tuesday, Feb. 10th.—School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. "The Lighting of Architecture," G. Grenfell Baines. 6 p.m.

Incorporated Plant Engineers

To-day, Feb. 6th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham. Discussion, led by B. G. Fletcher. 7.30 p.m.

Tuesday, Feb. 10th.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester. "The Burning of Low-Grade Fuel," J.H. Sutcliffe. 7.15 p.m.

Institute of British Foundrymen

Saturday, Feb. 7th.—LANCASHIRE BRANCH: Engineers' Club, Albert Square, Manchester. "The Stress Relief of Iron Castings," Report by Sub-Committee T.S. 17 of the Technical Council. 3 p.m.—WEST RIDING OF YORKSHIRE BRANCH: Technical College, Bradford. "Training within Industry for Supervisors," Ministry of Labour Regional Trainer. 6.30 p.m.

Monday, Feb. 9th.—SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield. "Fuel Economy in the Foundry," R. J. Sarjant. 7.30 p.m.

Wednesday, Feb. 11th.—EAST ANGLIAN SECTION: Central Hall, Ipswich. "Foundry Conditions, Personnel and Production," R. F. Coates. 7.30 p.m.

Friday, Feb. 13th.—MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. "The Influence of Production Flow on Moulding Methods in Iron Foundries and its Effects on P.M.H. and General Efficiency," R. C. Shepherd. 7 p.m.

Saturday, Feb. 14th.—BRISTOL AND WEST OF ENGLAND BRANCH: Grand Hotel, Broad Street, Bristol. "Roller Conveyor and its Application to the Foundry," J. Gardom. 3 p.m.—NEWCASTLE BRANCH: Neville Hall, Newcastle-upon-Tyne. "Some Practical Aspects of Bronze Founding," F. C. Evans. 6 p.m.—SCOTTISH BRANCH: Royal Technical College, George Street, Glasgow. "The Constant Charge Method of Cupola Operation," W. W. Braidwood. 3 p.m.

Institute of Economic Engineering

Saturday, Feb. 7th.—MIDLAND REGION: Chamber of Commerce, Birmingham. "Estimating for the General Engineer." 2.30 p.m.

Institute of Industrial Administration

Wednesday, Feb. 11th.—Grand Hotel, Birmingham. "Principles of Organisation," W. B. D. Brown. 6 p.m.

Institute of Marine Engineers

Monday, Feb. 9th.—JUNIOR SECTION: L.C.C. School of Engineering and Navigation," High Street Poplar, E.14. "The Combustion Turbine," J. Calderwood. 7.15 p.m.

Tuesday, Feb. 10th.—85, Minories, E.C.3. "Longitudinal Vibration of Marine Propeller Shafting," C. P. Rigby. 5.30 p.m.

Institute of Metals

Thursday, Feb. 12th.—LONDON BRANCH: 4, Grosvenor Gardens, S.W.1. "Metallurgical Problems of Importance in Aircraft," H. Sutton. 7 p.m.

Institute of Navigation

To-day, Feb. 6th.—Royal Geographical Society, 1, Kensington Gore, S.W.7. "A New System of Compass Correction," G. N. Harvey. 5.30 p.m.

Institute of Petroleum

Wednesday, Feb. 11th.—Manson House, 26, Portland Place, W.1. "Aerial Photography and Exploration for Oil," Ir. N. J. M. Taverne. 5.30 p.m.

Institute of Road Transport Engineers

Monday, Feb. 9th.—SCOTTISH CENTRE: North British Hotel, Edinburgh. "The Trend of Development in America," S. Hollands and G. D. Robinson. 7.30 p.m.

Institution of Chemical Engineers

To-day, Feb. 6th.—NORTH WESTERN BRANCH: College of Technology, Manchester. Annual General Meeting. "Coal Utilisation," D. T. A. Townend. 2 p.m.

Friday, Feb. 13th.—Institution of Civil Engineers, Great George Street, S.W.1. "Developments in the Industrial Production and Use of Gaseous Oxygen." 10 a.m. to 12 noon, 2 p.m. to 5 p.m.

Institution of Civil Engineers

To-day, Feb. 6th.—YORKSHIRE ASSOCIATION: Royal Victoria Station Hotel, Sheffield. "Surveying from Air Photographs," R. Franklin; "Drainage and Flood Control of Fens," M. D. Jeeps. 7 p.m.

Tuesday, Feb. 10th.—Great George Street, S.W.1. "The Development and Use of Barrel Vault Shell Concrete Roofing," C. V. Brumfield. 5.30 p.m.

Wednesday, Feb. 11th.—BIRMINGHAM AND DISTRICT ASSOCIATION: James Watt Memorial Institute, Great Charles Street, Birmingham. "The Place of the Engineer in the Post-War World," Sir Arthur P. M. Fleming. 7 p.m.

Thursday, Feb. 12th.—BIRMINGHAM AND DISTRICT ASSOCIATION: James Watt Memorial Institute, Great Charles Street, Birmingham. "A Unique Method of Constructing Hyperbolic Cooling Towers," B. G. Carroll. 6 p.m.—NEWCASTLE-UPON-TYNE AND DISTRICT ASSOCIATION: Spark's Café, High Street, Stockton-on-Tees. "Some Recent Developments in Railway Engineering," J. Taylor Thompson. 6 p.m.

Institution of Electrical Engineers

To-day, Feb. 6th.—SOUTH MIDLAND CENTRE: Grand Hotel, Birmingham. Annual Dinner. 6.30 p.m.

Saturday, Feb. 7th.—NORTH MIDLAND STUDENTS' SECTION: Visit to Bentley and Tempest, Ltd., Leeds. 2.15 p.m.

Monday, Feb. 9th.—SOUTH MIDLAND CENTRE: INSTALLATION/TRANSMISSION GROUP: Imperial Hotel, Temple Street, Birmingham. "The High-Pressure Mercury Vapour Discharge and its Applications," V. J. Francis and W. R. Stevens. 6 p.m.—LONDON STUDENTS' SECTION: Savoy Place, Victoria Embankment, W.C.2. "Rural Electrification," K. W. Wardrop. 7 p.m.

Tuesday, Feb. 10th.—RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2. Discussion on "The Maintenance of Television Receivers in the Home," opened by G. H. Watson. 5.30 p.m.—NORTH MIDLAND CENTRE: Corporation Electricity Department, Whitehall Road, Leeds. "Standardisation of Switchgear," D. E. Lambert and J. Christie. 6.30 p.m.

Wednesday, Feb. 11th.—TRANSMISSION SECTION: Savoy Place, Victoria Embankment, W.C.2. "Centralised Ripple Control on High-Voltage Networks," T. W. Ross and R. M. A. Smith. 5.30 p.m.—SOUTH MIDLAND CENTRE, STUDENTS' SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "The Engineer in the Post-War World," Sir Arthur P. M. Fleming. 7 p.m.

Thursday, Feb. 12th.—INSTALLATIONS SECTION: Savoy Place, Victoria Embankment, W.C.2. "The Application of Electricity to Horticulture," C. A. Cameron Brown and E. W. Golding. 5.30 p.m.

Institution of Engineers and Shipbuilders in Scotland

Tuesday, Feb. 10th.—39, Elmbank Crescent, Glasgow. "Developments in Frozen Foods and their Effects on the Design of Ships' Refrigerating Equipment," A. J. M. Smith and J. D. Farmer. 6.30 p.m.

Institution of Engineers in Charge

Wednesday, Feb. 11th.—St. Bride Institute, Bride Lane Fleet Street, E.C.4. "Industrial Infra-Red (Radiant Heating)," A. C. F. Mackadam. 6.30 p.m.

Institution of Heating and Ventilating Engineers

Wednesday, Feb. 11th.—Institution of Civil Engineers, Great George Street, S.W.1. Ordinary meeting. 2.30 p.m.

Institution of Locomotive Engineers

Wednesday, Feb. 11th.—Institution of Mechanical Engineers, Storey's Gate, S.W.1. "Some Aspects of Carriage Bogie Design," Jury Koffman. 5.30 p.m.

Institution of Mechanical Engineers

To-day, Feb. 6th.—Storey's Gate, St. James's Park, S.W.1. "Mechanical Engineering Aspects of Naval Mining," E. C. Wadlow and "Some Mechanical Features in Anti-Submarine Weapons," J. M. Kirkby. 5.30 p.m.—SCOTTISH BRANCH: Robert Gordon's College, Aberdeen. "The Gas Turbine and Marine Propulsion," T. A. Crowe. 7.45 p.m.

Saturday, Feb. 7th.—SCOTTISH BRANCH: Technical College, Dundee. "The Gas Turbine and Marine Propulsion," T. A. Crowe. 7.15 p.m.

Monday, Feb. 9th.—EAST MIDLANDS BRANCH: Technical College, Newark. "High-Pressure Reciprocating Pumps," J. T. Lewis. 7.30 p.m.

Tuesday, Feb. 10th.—COVENTRY AUTOMOBILE DIVISION: Geisha Café, Hertford Street, Coventry. "Test Methods and Some Instruments," E. B. Stead. 7 p.m.

Friday, Feb. 13th.—Storey's Gate, St. James's Park, S.W.1. "Torsional Fatigue Testing of Marine Shafting," S. F. Dorey. 5.30 p.m.—EAST MIDLANDS BRANCH: Technical College, Lincoln. "Applications of Electricity to Agriculture," W. Cover. 7.15 p.m.

Institution of Production Engineers

Saturday, Feb. 7th.—YORKSHIRE GRADUATE SECTION: Visit to Jowett Cars, Ltd., Idle, near Bradford. 2.30 p.m.

Monday, Feb. 9th.—HALIFAX SECTION: Whiteley's Café, Westgate, Huddersfield. "Cutting Lubricants and Coolants," H. H. Beeny. 7 p.m.—LUTON SECTION: Town Hall, Luton. "Management," C. W. Mustill. 7 p.m.

Tuesday, Feb. 10th.—BIRMINGHAM GRADUATE SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Bearings Production," W. H. Lilly. 7.15 p.m.

Wednesday, Feb. 11th.—SOUTHERN SECTION: University College, Southampton. Colour film and lecture on "Die Casting." 7.30 p.m.—SHEFFIELD SECTION: Royal Victoria Hotel, Sheffield. "Wire Drawing and Wire Drawing Machinery," H. Richards. 6.30 p.m.—WESTERN SECTION: The College, Swindon. "Jig and Tool Design," R. O. Jeakings. 7.30 p.m.

Thursday, Feb. 12th.—LONDON GRADUATE SECTION: Waldorf Hotel, Aldwych, W.C.2. "Sand Casting," Mr. Challis. 7 p.m.—LONDON SECTION: Royal Empire Society, Northumberland Avenue, W.C.2. "Inspection: Small Batch Inspection and Large Scale Production Inspection," P. S. Crooke and A. G. Powell. 7 p.m.

Institution of the Rubber Industry

Monday, Feb. 9th.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. Symposium on "Colour in the Rubber Industry." 7.15 p.m.—PRESTON SECTION: Victoria and Station Hotel, Preston. "Training within Industry for Supervisors," N. G. L. Percival. 7 p.m.

Institution of Structural Engineers

Thursday, Feb. 12th.—11, Upper Belgrave Street, S.W.1. "Structural Engineering Research at the Building Research Station," F. G. Thomas. 5.55 p.m.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. "Modern Industrial Design," C. A. Harding. 6.30 p.m.

Friday, Feb. 13th.—LANCASHIRE AND CHESHIRE BRANCH: College of Technology, Manchester. "Timber as an Engineering Material," Phillip O. Reece. 7 p.m.

Junior Institution of Engineers

To-day, Feb. 6th.—39, Victoria Street, S.W.1. "Power Transmission in Diesel-Electric Locomotives," T. Schur. 6.30 p.m.

Monday, Feb. 9th.—SHEFFIELD AND DISTRICT SECTION: Metallurgical Club, West Street, Sheffield. Discussion on "The Engineering Industry: Past, Present and Future," opened by Mr. McGuire. 7.30 p.m.

Tuesday, Feb. 10th.—WESTERN GROUP OF MEMBERS: Technical College, Bath. "Engineers in Tanks," G. L. Watkinson. 7.30 p.m.

Friday, Feb. 13th.—39, Victoria Street, S.W.1. "A Passenger Chassis for Service in India," W. J. Kease. 6.30 p.m.—SOUTH MIDLAND GROUP OF MEMBERS: Technical College, Park Square, Luton. "The General Application of Measuring Instruments to Industry," C. W. Terry. 7.30 p.m.

Manchester Association of Engineers

To-day, Feb. 6th.—Engineers' Club, Albert Square, Manchester. "Fuel Efficiency," A. C. Dunningham. 6.45 p.m.

Newcomen Society

Wednesday, Feb. 11th.—Chartered Institute of Patent Agents, Staple Inn Buildings, W.C.1. "Trevithick and the Merthyr Tramroad," S. Mercer. 5.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Feb. 6th.—Mining Institute, Newcastle-upon-Tyne. "Alternating Current for Ship's Auxiliaries," A. N. Savage. 6.15 p.m.

Wednesday, Feb. 11th.—Bolbec Hall, Newcastle-upon-Tyne. "Works and Maintenance Engineering," W. Cutter. 6.45 p.m.

Royal Aeronautical Society

Thursday, Feb. 12th.—Institution of Civil Engineers, Great George Street, S.W.1. "The Aerodynamics of the Gas Turbine," A. R. Howell. 6 p.m.

Royal Statistical Society

To-day, Feb. 6th.—LONDON GROUP: E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, W.C.2. "Quality Control in Europe," Dr. Geiss. 6 p.m.

West of Scotland Iron and Steel Institute

Friday, Feb. 13th.—39, Elmbank Crescent, Glasgow. "The Application of Fuel Oil and Surplus Gas at the Irlam Works of the Lancashire Steel Corporation, Ltd.," J. Sinclair Kerr. 6 p.m.

Personal and Business

MR. R. BENNETT has been appointed chairman of Smethwick Drop Forgings, Ltd.

MR. KENNETH MARSHALL has been appointed Director of the Joint Iron Council.

MR. EDWARD JONES has been appointed sales manager of Towler Brothers (Patents), Ltd.

THE HOFFMANN MANUFACTURING COMPANY, Ltd. has opened a branch office at 23, Dublin Road, Belfast (telephone, Belfast 20741).

SIR GEORGE P. CHRISTOPHER has been nominated President, and Mr. Colin S. Anderson, Vice-President, of the Chamber of Shipping of the United Kingdom.

MR. N. E. KEARLEY, A.M.I.E.E., deputy director of the Council of Industrial Design, has resumed duty in the Electrical Plant Division of the Ministry of Supply.

MR. F. H. MAIDEN, A.M.I.Mech.E., has been appointed contracts manager of the turbine contracts department of the Brush Electrical Engineering Company, Ltd., in succession to Mr. H. Roberts, who has retired on account of ill-health.

AERO RESEARCH, Ltd., has concluded arrangements with Ciba, Ltd., for the manufacturing rights of various plastics, including melamine formaldehyde resins for textiles, wet strength paper and other applications, as well as the new metal-to-metal adhesive and casting resin known as "Araldite."

A Seven-Day Journal

British Electricity Authority Appointments

THE British Electricity Authority has this week announced the appointment of Mr. L. J. Luffingham as its Public Relations Officer. Mr. Luffingham is a chartered electrical engineer with nearly thirty years' experience of the electrical industry and of technical journalism, and is at present Editor of our contemporary, *The Electrical Times*. Mr. W. J. Hendry, press liaison officer of the Central Electricity Board, and Mr. G. Grant McKenzie, formerly Director of the Information Office in the British Embassy at Washington, have been appointed Deputy Public Relations Officers to the Authority. Another appointment which has just been announced is that of Mr. J. W. Thomas, B.Sc., LL.B., M.I.E.E., as Chief Education and Training Officer of the British Electricity Authority. For the past three years Mr. Thomas has been secretary of the British Engineers' Association, and throughout the whole of his career has had considerable experience in teaching, personnel selection and education committee work.

The Gauge and Toolmakers' Association

A LUNCHEON arranged by the Gauge and Toolmakers' Association took place on Thursday, February 5th, at the Savoy Hotel, and the guest of honour was Mr. Oliver Lyttelton. There was a large gathering of members and guests, and the chair was taken by the President of the Association, Mr. F. W. Halliwell. In introducing Mr. Oliver Lyttelton, he made reference to his services as Minister of Production during the last war, and his high place in industry. He said that while the Association was interested in export trade, it was, he felt, their first duty to equip our own manufacturers with the necessary tools, to enable them to make and export their goods. It would be a short-sighted policy, he felt, to export their equipment until they had completely satisfied the home demand, and he commended that action to the friends of the Association, the Machine Tool Trades Association. With regard to controls, he suggested that the Government should give sympathetic consideration to the removal of controls from all special tool steels and die steels, in the same way that they had been removed from high-speed steel. If they were only allowed their quota they would be out of steel stocks within six to nine months. If the industry was only allowed to carry on as it did during the war, then it would be in a position to supply all the gauge and tool equipment that was needed. In the earlier part of his speech, Mr. Lyttelton urged the importance of employers and their associations' putting forward their own points of view when the Government sought to introduce measures which they thought were against the national interest or their own personal interests. With regard to industrial policy, Mr. Lyttelton said that the great mistake of the present Government was their attempt to run industries in detail from the centre, on the false assumption that the Government knew more about the industry or business than the people who carried it on. He did not believe that we should ever get our affairs into proper balance without the restoration of price mechanism and the haggle and freedom of the market.

New Ships for the British India Company

IT is announced by the British India Steam Navigation Company, Ltd., that it has ordered four more cargo ships and one small passenger ship, bringing its total now building or on order to twenty-one. With the thirty-three vessels built during and since the war, this means that its losses of fifty-one during hostilities should, by the next two years, be fully accounted for. Two motor cargo liners of the "C" class are to be built at Swan Hunters' Neptune yard, with Doxford engines intended to give a service speed of 14½ knots. They will have a gross tonnage of 7000 and a deadweight of 10,000 tons, with 24,000 cubic feet of refrigerated space but with machinery for 100,000 cubic feet, if it is desired to extend such space. They will carry twelve passengers in single and two-berth cabins, each with its own bathroom. These two ships can serve equally well on the Australian or East African routes or on the B.I. service between India and Australia. Two more oil-burning steamers of the "Ormara" type are to be built by William Denny and Bros., of Dumbarton. They will have a gross tonnage of 5500 and a deadweight of 9200, with a total capacity of 490,000 cubic feet. They are to have reciprocating engines with Bauer-Wach turbines giving a speed on service of 12 knots. Their design will enable them to be employed on any of the B.I. Company's main services. The fifth vessel will be a small motorship of 2000 tons deadweight, to be built by Henry Robb and Co., at Leith. She is intended to serve the smaller ports on the East African Coast, and will carry twenty first, twenty-eight second, and 300 unberthed passengers. The service speed will be 14 knots. In connection with the breaking up of the old troop ship, "Nevasa," it is announced that the company has presented the ship's bell to the Boy Scouts Association, and that it will hang in an honoured place in the Lord Baden-Powell Memorial Room at the Imperial Headquarters in London.

Factory and Works Managers Institutions Amalgamation

IT is officially announced by the General Secretary and Treasurer of the Institution of Factory Managers, Mr. Charles Brown and Mr. T. J. Wells, the General Secretary of the Institution of Works Managers, and their Councils, that there is a unanimous desire to proceed with the proposed amalgamation of the two Institutions. It will be recalled that in November last year, in furtherance of the co-operative spirit which exists in the vital field of industrial management, the idea of merging the interests of the two Institutions was put forward. Representatives of the two bodies were duly appointed and they have now agreed to proceed. The proposals which have been agreed upon will be submitted to general meetings of the two Institutions, and each Council will strongly recommend their acceptance.

Dr. F. H. Todd's Appointment

IT is announced that Dr. F. H. Todd, Ph.D., B.Sc., M.I.N.A., has resigned his post as Principal Scientific Officer of the Ship Division at the National Physical Laboratory, Teddington, and has accepted a post as chief naval architect to the Hydrodynamics Division of the David Taylor Model Basin at Washington, D.C. Dr. Todd, who joined the staff of the William Froude Tank in 1928, was educated at Barnard Castle School, and served his apprenticeship in the Walker-on-Tyne yard of Sir W. G. Armstrong Whitworth and Co., Ltd. He received his academic training at King's College, Newcastle-on-Tyne, where he held the North East Coast Institution Scholarship, the Charles Mather Scholarship, and the Worshipful Company of Shipwrights' Scholarship. In 1925 he gained his B.Sc. degree in naval architecture and the following year was awarded the 1851 Exhibition Scholarship of the Institution of Naval Architects. His post-graduate course at King's College was devoted to the problems of ship vibration, a subject on which he has read several papers. A thesis on this subject gained for him the Ph.D. degree of Durham University. He returned to the College for about one year on the retirement of Sir Westcott Abell from the chair of Naval Architecture, and on his return to Teddington was appointed chief assistant to Mr. J. L. Kent, who succeeded Dr. G. S. Baker as Superintendent of the Ship Division. Later he was appointed Principal Scientific Officer of the Ship Division. In 1947 Dr. Todd visited the principal experimental tanks of the world, with a view to preparing the designs for another model tank for Teddington. He is a valued member of the Institution of Naval Architects. The exact date at which Dr. Todd will take up his duties at Washington will be announced later.

The Gas Industry

THE British Gas Council has prepared and published a report entitled "The Gas Industry: Facts and Figures," which is intended for the immediate use and future reference of all those interested, directly and indirectly, in the proceedings in Parliament on the Bill for nationalising the industry. The Bill was debated on its second reading on Tuesday and Wednesday of this week. The report presents comprehensive facts and figures relating to the development, structure and legislative control of the British gas industry, and outlines some proposals for integration without recourse to nationalisation. It also emphasises the importance to the nation of coal carbonisation and draws attention to the excellent relationship between gas undertakings and their employees, nearly half of whom are co-partners. The British Gas Council's policy towards nationalisation is set out in the document. It suggests that the position of the electricity industry was from many aspects different from that of the gas industry, and afforded arguments for the nationalisation of electricity which are not applicable to the nationalisation of gas.

Reports on German Industry

FOR many months past we have published regularly in our columns lists of reports on German industry, which have been compiled by the British Intelligence Objectives Sub-Committee, the Field Information Agency, and the Combined Intelligence Objects Sub-Committee. The Board of Trade has now announced that actual investigations in Germany ended in June last, and that up to date 2720 reports have been issued covering studies in which more than 6000 investigators have taken part. The task of preparing these reports on different aspects of German industry is now rapidly being completed, and already over a million copies have been sold or distributed to Universities, learned societies, trade and research associations, and the principal public libraries of this country. In order to assess how German methods can be adopted for the benefit of Britain and where German research was behind this country's, the Board of Trade has approached experts in each of the major industrial fields covered to provide comments on which critical summaries suitable for publication may be based. These critical reports are now being prepared and will be known as "B.I.O.S. Overall Reports." In all, there will be fifty of them, each containing from 10,000 to 50,000 words, and it is expected that printing will be concluded by the end of June next. The Board of Trade says that the reports have been prepared because it has been generally realised that such critical summaries will be of great help to those in industry and in Government departments who have a decisive influence on research and development policy in the coming years. It is hoped that the reports will give a clear answer as to how Britain can best utilise the new developments in Germany which have been revealed by the full investigation of industry in that country. Advance copies of the overall reports can be ordered through H.M. Stationery Office, P.O. Box 569, London, S.E.1, and a list indicating the subjects covered may be obtained from the Board of Trade, T.I.D.U., Research Section, 40, Cadogan Square, London, S.W.1.

Present Day Locomotive Working in Great Britain *

By O. S. NOCK, B.Sc.

No. III—THE G.W.R. OIL-FIRED 4-6-0's—Part II

(*Continued from page 130, February 6th*)

PLYMOUTH-PENZANCE

ON the Cornish road my footplate observations were made on the "Castle" class engine No. 5079 "Lysander," at that time stationed at Laira shed, Plymouth. The engine was regularly working, week in, week out, a double-manned turn involving a daily mileage of 320 as follows :—

5.12 a.m. Express parcels train, Plymouth to Penzance, due 8.5 a.m.

9.45 a.m. Up Cornish Riviera Express, due Plymouth 12.10 p.m.

3.15 p.m. Down Cornish Riviera Express, due Penzance 5.35 p.m.

7.20 p.m. Up stopping passenger train, due Plymouth 10.40 p.m.

The daily utilisation of the engine was thus 46 per cent. Refuelling was done at Plymouth. I travelled on the engine between Plymouth and Penzance in each direction with the Cornish Riviera Express and noted the punctual working of that popular train on occasions when it was patronised almost to the point of overflowing. In addition to these trips, on a third occasion when I was a passenger by the train it was taken by an oil-fired engine of the "Hall" class.

On a road such as this, with constantly changing gradients, and where the presence of severe curves makes it impossible to take advantage of the downhill stretches by running fast, the demands made upon a locomotive can be judged more comprehensively by an analysis of the manner in which she is required to be steamed rather than by reference to point-to-point speeds, individual gradients and the immense amount of detail that would be involved thereby. A preliminary guide to the standards of running required may be gained from the maximum loads specified to be taken unassisted by the "Hall" and "Castle" class engines; for the former, having 27,275 lb nominal tractive effort, the load is 380 tons, and for the latter with 31,625 lb of tractive effort, the load is 420 tons. With a ruling gradient of 1 in 57 and inclines like that from Par Harbour to St. Austell, where in 3¾ miles an aggregate of 2¾ miles are graded between 1 in 60 and 64, these loadings clearly call for exceptional uphill work. The maximum tonnages are, however, not very often approached, though in pre-war days the Cornish Riviera Express, when carrying through coaches from London to Newquay, used sometimes to load to over 400 tons tare between Plymouth and Par. So that a general impression may be obtained of the character of the road the reduced scale-gradient diagram, Fig. 6, has been prepared.

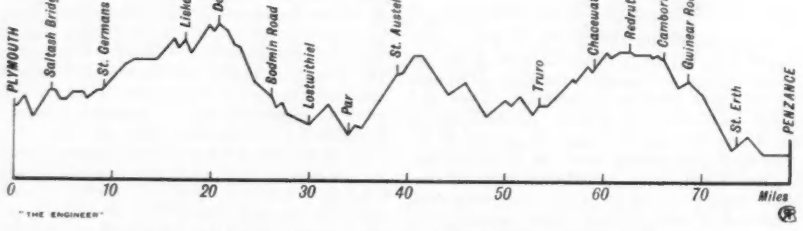


FIG. 6—CORNISH MAIN LINE, G.W.R. GRADIENT PROFILE

Coming now to the working of the engine "Lysander" on the westbound Cornish Riviera Express, the load was 331 tons tare and 360 tons gross behind the tender, and the enginemen, Driver Mack and Fireman Martin, of Plymouth. We were accompanied by Inspector Vercoe, of Newton Abbot. Apart from a stiff ¼ mile at 1 in 59 up to Devonport station, the start westbound from Plymouth is deceptively easy; one gets away in great style on the descent past Keyham, with its striking views of the dockyard, and on this run we very quickly reached 55 m.p.h. Then comes the deeply impressive passage, at slow speed, over the Royal Albert Bridge. No one of our calling seeing this bridge and reading those simple words, "1859, I. K. Brunel, Engineer," displayed over the entrance arch can feel anything but pride in so magnificent and lasting a monument to early British railway engineering skill. After giving up the single-line token at Saltash recovery in speed was swift alongside the tidal creeks of the Lynher River, with its memories of Brunel's picturesque timber viaducts; but once over the Lynher viaduct collar work begins in real earnest.

The working of the locomotive throughout from Plymouth to Penzance is given in Fig. 7, in which the cut-offs while steaming are plotted on a time basis. The contrast between the service requirements of this road and of that between Paddington and Bristol are strongly marked and this contrast would have been still more striking had not the Bristol train been subjected to the series of signal and engineering slacks. With a clear road the steaming conditions would have been practically constant from minutes 50 to 100 out of Paddington, followed perhaps by an easier spell down the Dauntsey incline. Apart from a relaying slack through Redruth, where a speed restriction is in any case regularly enforced, the down Cornish Riviera Express had a clear road from start to finish.

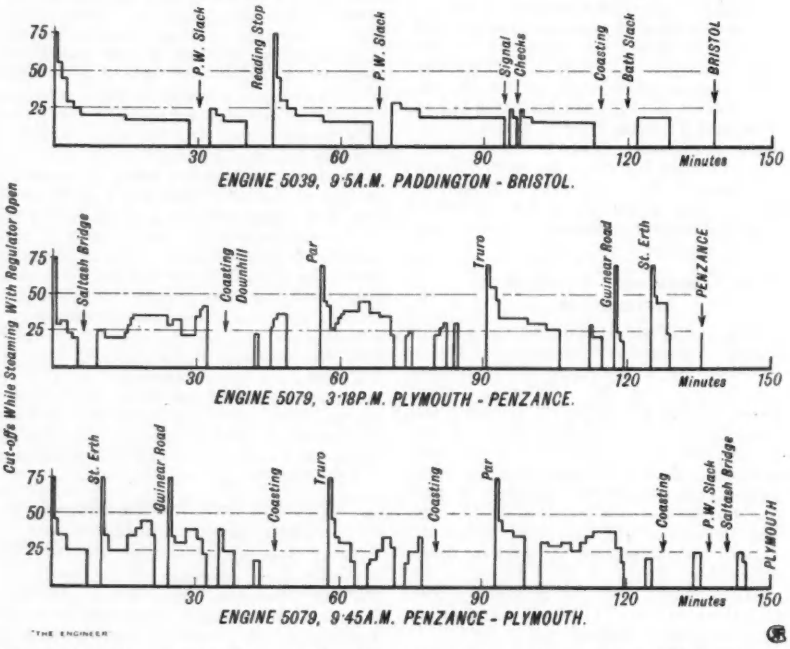


FIG. 7—COMPARISON OF ENGINE WORKING ON BRISTOL AND CORNISH MAIN LINES

The section from Par to Truro is typical of the very heavy work required on the Cornish road and full details of the running are given in Fig. 8. It will be seen that although the cut-off was advanced finally to 45 per cent, speed on the 1 in 57 gradient approaching St. Austell fell to 19 m.p.h. After passing the summit point at Burngullow, 6·9 miles from Par in 15¾ min., the switch-back section to Truro was taken as fast as practicable, paying due regard to the incessantly curving nature of the road. The sectional timing between Par and Truro appears to be almost a counsel of perfection, for, in spite of the hard, uphill work to Burngullow 2 min. were lost on the 29 min. allowance for the 19 mile run. With load reduced to nine coaches, 325 gross tons behind the tender some good work was done up the long incline to Chacewater; with cut-off at 34 per cent, the lowest speed was 30 m.p.h. on the continuous 1 in 70 gradient. Despite the heavy slack at Redruth, sectional timing from Truro to Gwinear Road was practically observed.

The running times at principal stations,

* The first article, entitled "The L.N.E.R. 2-6-2 'Green Arrow' Class", appeared October 11, 1946; the second, entitled "The L.M.S.R. 'Coronation' Class Pacifics", appeared December 13 and 20, 1946.

summit points, and so on, are set out below in comparison with those made by the "Hall" class engine "No. 3955" in similar conditions of loading.

The latter engine was stopped by signal on the Devon side of the Royal Albert Bridge awaiting the clearance of an up-train from the single-line section, and by comparison of the times this delay cost at least 5½ min. in running. But it is clear that some excellent work was subsequently got out of the engine, for the running time between Saltash and the summit point at Doublebois was 1¼ min. faster than that of the "Castle" over the same stretch. The smaller boiler of the "Hall" was evidently being efficiently steamed, though on the heavier gradients, where the cut-off needs to be advanced well beyond 30 per cent, the valve setting of the two-cylinder engine, equipped with Stephenson link motion, would tend to give a more efficient cylinder performance. With this rate of admission there would be little, or no lead, against the constant $\frac{3}{16}$ in lead of the "Castle." On the ascents from Par and from Truro the "Hall" class engine did not show up quite so well, though, of course, the "Castle" has always the advantage of 16 per cent more tractive effort. But the running of engine "No. 3955" in these arduous conditions is enough to indicate that the application of oil firing to the "Hall" class is no less successful than on the "Castles."

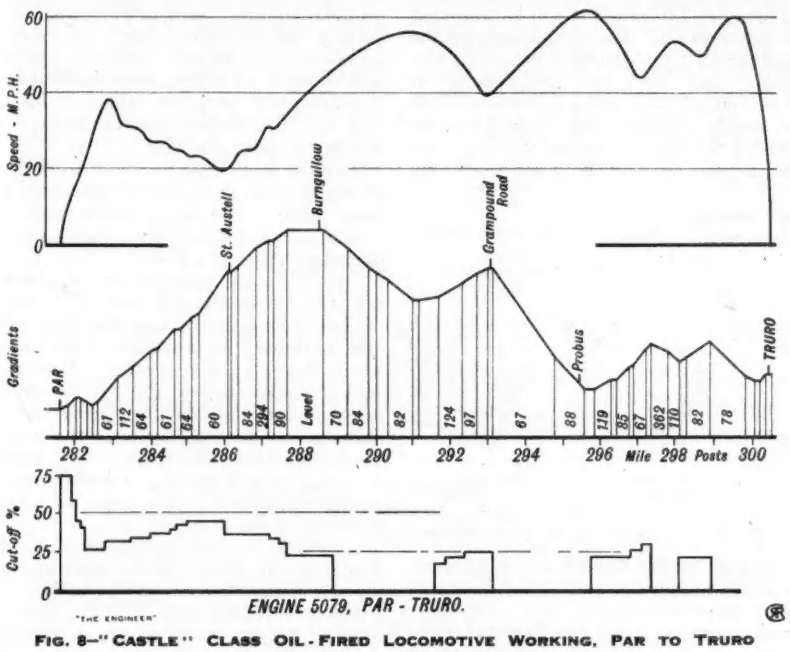


FIG. 8—"CASTLE" CLASS OIL-FIRED LOCOMOTIVE WORKING, PAR TO TRURO

G.W.R. Cornish Riviera Express—Westbound

Engine No.		5079	3955
Engine name		"Lysander"	"Haberfield Hall"
Class		"Castle"	"Hall"
Load, gross tons behind tender		365	355
Miles	**Booked time**	**Actual time min. sec.**	**Actual time min. sec.**
0.0 Plymouth	0	0 00	0 00
1.2 Devonport	–	3 17	3 30
			signal stop 2¾ min.
4.2 Saltash	9	8 38	14 20
9.3 St. Germans	–	15 32	21 00
17.8 Liskeard	29	29 22	34 05
21.1 Doublebois	34	34 37	39 05
34.7 Par	52	52 25	56 40
0.0	0	0 00	0 00
4.5 St. Austell	–	11 10	11 52
6.9 Burngullow	–	15 52	16 37
19.0 Truro	29	31 02	32 10
Loads reduced to		325	315
0.0 Truro	0	0 00	0 00
5.2 Chacewater Jct.	9	10 39 p.w. slack Redruth	11 49 p.w. slack Redruth
12.7 Camborne	–	21 23	23 27
15.2 Gwinear Road	24	24 33	26 26
0.0	0	0 00	0 00
5.0 St. Erth	7	7 05	6 55
0.0	0	0 00	—
5.6 Penzance	10	9 57	—

PENZANCE TO PLYMOUTH

The remaining run was made on the footplate of "No. 5079," "Lysander," on the eastbound Cornish Riviera Express, with a load of ten coaches throughout from Penzance to Plymouth. The tare load was one of 324 tons. At each intermediate stop the station platform was thronged with passengers and I estimate that from a starting load of 345 tons gross, from Penzance, the tonnage was increased to 360 tons by Truro and finally to 365 tons on leaving Par for Plymouth. The engine was worked by Driver Warne and Fireman Leach, of Laira shed, with Locomotive Inspector Vercoe again with us on the footplate. The accompanying log shows how closely the intermediate timings were kept, despite the incidence of several engineers' slacks, and details of the working are shown diagrammatically in Fig. 7, on a time basis, so that comparison can be made readily with the effort required on the westbound run, and with that on the 9.5 a.m. express from Paddington to Bristol.

The hardest running in this direction was required between Par and Liskeard, and this is shown graphically, with all details of the engine working in Fig. 9. Scenically, too, it is the finest section of the journey, where the line climbs from the beautiful wooded valley of the Fowey River at Lostwithiel higher and higher up the hillside, through the Largin woods to the moorland watershed between Doublebois and Liskeard. The critical length from the locomotive point of view is the section of reverse curvature from West Largin viaduct, where the gradient is 1 in 70. It was here that the cut-off was advanced to its maximum of 40 per cent and speed maintained at 22½ m.p.h.

Although the train passed Liskeard 7 min. late, due largely to the time taken at intermediate stops to entrain so many passengers, it would have been most injudicious to attempt any substantial regaining of lost time on the downhill stretches. Speed was not allowed to exceed 60 m.p.h. on the steep descent towards St. Germans, and was mostly restrained at much below that figure. On these stretches of easy steaming and also while coasting and standing the oil-feed regulator was set at "15" against "35" to "40" when going hard uphill. These figures should not be used as a basis of comparison between engines "5039" and "5079," for as previously

Cornish Riviera Express—Eastbound

Miles	Booked time	Actual time
		min. sec.
0.0 Penzance	0	0 00
5.6 St. Erth	9	9 07
0.0	0	0 00
5.0 Gwinear Road	10	10 27
0.0	0	0 00
4.1 Carn Brea	8	7 52
—	—	p.w. slack Redruth
10.0 Chacewater	16	17 46
15.2 Truro	24	24 53
0.0	0	0 00
7.7 Grampound Road	12	12 53
14.5 St. Austell	22½	23 47
19.0 Par	29	29 25
0.0	0	0 00
—	—	p.w. slack Lostwithiel
7.8 Bodmin Road	13	14 39
16.9 Liskeard	29	30 53
—	—	p.w. slack Defiance
30.5 Saltash	48	49 12
34.2 Devonport Jct.	55	54 14
—	—	signal check
34.7 Plymouth	57	57 15

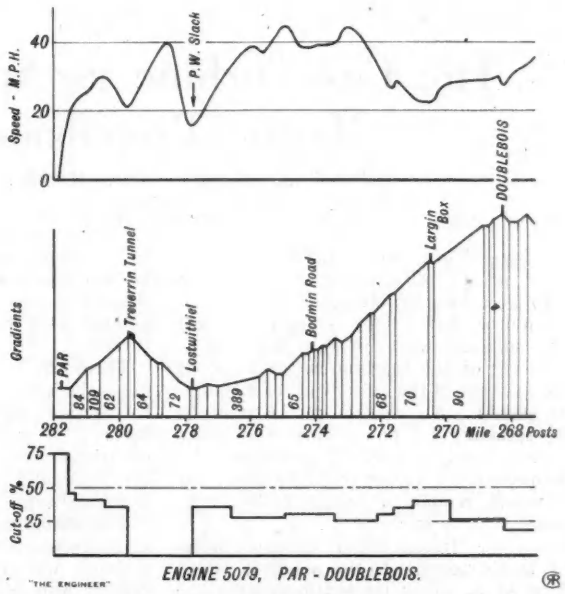


FIG. 9—"CASTLE" CLASS LOCOMOTIVE WORKING, PAR TO DOUBLEBOIS

explained the readings shown on the pointer scale of the former engine were relative only. On arrival at Plymouth "No. 5079" was detached and went at once for 1½ miles down the main line to Laira shed, so preceding the Cornish Riviera Express itself, which did not leave Plymouth until 12.25 p.m., 10 min. after its arrival from Penzance. "No. 5079," after refuelling, arrived back in North Road station at 2.40 p.m., to wait on the spur for the down express, due at 3.10 p.m.

The two runs in Cornwall showed an almost identical oil consumption in eastbound and westbound directions, 370 and 380 gallons, respectively, while the corresponding water consumption was approximately 2700 and 2900 gallons. The evaporation thus appears to have been considerably less per gallon of oil than on the Bristol run. On the other hand, one cannot overstress the difficulty of the working conditions in Cornwall, not only when fighting a heavy gradient but in the extreme fluctuations of demand upon the locomotive. For instance, on the eastbound Cornish Riviera Express the engine was being steamed hard for only 47 per cent of journey time, whereas on the 9.5 p.m. from Paddington to Bristol the main valve of the regulator was open for 85 per cent of journey time. Without the effect of the blast, evaporation would be less efficient and the high proportion of coasting and standing time on the Cornish road would naturally take its toll. The oil and water consumptions on the three journeys are summarised in the accompanying table, and it will be seen that when the water-oil rate is compared to the percentage of total journey time that the regulator was open the performance of engines "5039" and "5079" becomes much more nearly related, near enough to be accounted for by the normal variation one would expect to find between individual engines and by the limited degree of accuracy with which water and oil levels can be read on the tender gauges.

G.W.R. Oil-fired "Castle" Working

Engine No.	5039	5079	5079
Engine Name	"Rhuddlan Castle"	"Lysander"	"Lysander"
Load behind tender, gross tons	375	365 to Truro 325 to Penzance	345/365
Train	9.5 a.m. ex Paddington	Down "Cornish Riviera"	Up "Cornish Riviera"
Length of trip, miles	118·3	79·5	79·5
Total time of trip	138¼ min.	135¼ min.	150¼ min.
Water consumption, gallons	3600	2900	2700
Oil consumption, gallons	340	380	370
Water per train mile	30·4	36·5	34·0
Oil per train mile	2·88	4·78	4·65
Evaporation: gallon of water/gallon of oil	10·5	7·6	7·3
Ratio "A": percentage of total time in which engine was steamed	85 per cent	56 per cent	47 per cent
Evaporation: ratio "A"	0·124	0·135	0·155
Overall speed of trip, m.p.h.	51·4	35·2	31·7

Apart, however, from the finer points of performance, it is evident that the Great Western Railway has already developed this system of oil-firing to a commendable degree of reliability and the saving in coal is being effected without any deterioration in the service; indeed, most enginemen with whom I have spoken recently expressed the view that the oil-burners are proving the most reliable steamers they have ever worked. As one fireman put it: "you just can't knock her off the '225.'"

The Gas Turbine as Applied to Marine Propulsion*

By T. A. CROWE, M.Sc., M.I.Mech.E.†

No. III—(*Continued from page 132, February 6th*)

Starting.—A gas turbine, unlike the steam turbine, is not self-starting, but must be run up to a considerable speed by an auxiliary motor before the compressor will deliver sufficient air to operate the turbine. The power of the starting motor is about 4 or 5 per cent of the net output of medium-sized plants. An electric motor may be used, receiving its power from the ship's auxiliary diesel generators; alternatively, a compressed air motor could be used, but this would require a rather bulky high-pressure air reservoir.

Reversing.—In selecting a system of reversing it is not possible to use a simple astern turbine as in steam installations, since the windage losses in an idling gas turbine would be excessive, and would cause serious troubles due to overheating. An astern gas turbine could only be used if clutches were fitted to both the ahead and astern turbines, so that the one not in use could be disconnected from the reduction gears. The provision of the necessary stop valves in the high-temperature gas pipes would be troublesome, and serious temperature stresses would be set up by the sudden admission of the hot gases to the astern turbine.

There are, however, four means of obtaining satisfactory reversing without having to reverse the actual turbines, namely, by: (1) variable-pitch propeller; (2) electric drive; (3) reversing gears, and (4) hydraulic reversing coupling of the Föttinger type.

The variable-pitch propeller is attractive in many ways, for not only does it provide a simple and rapid method of manœuvring, but it also enables higher propeller efficiencies to be obtained when the ship is operating outside its designed conditions. For example, when the ship's resistance has increased, owing to bad weather or a fouled hull, the pitch of the blades may be adjusted to suit the reduced speed of the ship.

I do not intend to enlarge on the various types of variable-pitch propellers which are now on the market, and which differ from each other primarily in the operating mechanism, and in the method of pivoting the blades in the hub. These points, and the general characteristics of variable-pitch propellers, have recently been fully described (Taylor, 1946)‡. It does appear, however, that the modern robust designs have overcome the difficulties which were experienced with the early types, and which gave the variable-pitch propeller a bad name. Satisfactory results have now been obtained on ocean going ships of 3500 h.p. per shaft, and there is no reason to suppose that the variable-pitch propeller will not be suitable for the largest powers likely to be adopted in marine service.

Electric propulsion is a well-tried system of control, and the great strides which have been made in its development and application during the last few years have been described (Watson, 1946)§. The efficiency of this type of transmission is about 93 per cent, compared with about 97 per cent for the geared drive, and the total cost of the machinery in a turbo-electric ship is about 5–6 per cent greater. However, a saving in space and weight may be obtained in some installations by placing the synchronous motor well towards the stern of the ship, thus shortening the shafting. The ease of manœuvring, together with its proved reliability, may ensure its adoption in certain installations.

Although reversing gears have not been made for the larger powers used in marine service, interesting designs have been developed by Modern Wheel Drive, Ltd., and one of their gears is shown in section in Fig. 9. On the driving, or upper, shaft two gears are rigidly fixed, the left-hand one meshing directly with a gear running on the driven shaft below. The right-hand gear drives the second gear on the lower shaft, through an idling pinion behind, so that the two lower gears, which are free to rotate on their shaft, are driven continuously in contrary directions. Inside each of these two driven gears is a multicone, oil-operated clutch. When it is desired to go ahead the clutch in the left-hand gear is engaged by admitting pressure oil through the appropriate duct in the shaft, so that the gear is gripped firmly to the driven shaft. When going astern, the clutch in the left-hand gear is released and that in the right-hand gear engaged. Reversing gears of this type have already been made for powers up to 1600 s.h.p., and designs have been prepared for transmitting 24,000 s.h.p.

Fig. 10 shows diagrammatically a section through a hydraulic reversing-mechanism, which may be installed between the turbine and reduction gears, or between the reduction gears and propeller, according to where the torque and speed conditions are most suitable. Ahead drive is transmitted directly through the multicone clutch, pressure oil being admitted for this purpose between the two multicone discs. These are keyed on to the driving shaft, and the oil pressure forces them into contact with the driven member, thus locking the two shafts together. The astern drive is obtained by releasing the clutch and filling the blade system of the Föttinger type reversing coupling with oil. The efficiency of the astern drive will be in the order of 60–70 per cent, but the only losses which will occur while going ahead will be due to windage in the hydraulic coupling.

Materials.—As already noted, one of the principal reasons for the slow development

* Institution of Mechanical Engineers. January 23rd. Twentieth Thomas Lowe Gray Lecture. Abstract.

† Engineering Director, John Brown and Co., Ltd., Clydebank.

‡ Taylor, J. Lockwood, 1946, "Proc.," I.Mech.E., Vol. 155, page 211, "The Variable-Pitch Marine Propeller."

§ Watson, G. O., 1946 "Proc.," I.Mech.E., Vol. 154, page 380, "Recent Developments in Alternating-Current Turbo-Electric Ship Propulsion."

of the gas turbine was the difficulty of obtaining high-temperature resisting materials, and the metallurgist continues to find the demands of the gas turbine designer quite insatiable. The attainment of higher efficiencies through higher turbine inlet temperatures will always be limited by the properties of the available materials.

Considerable work has been done in developing ceramics for turbine blades, but the brittleness of the material will probably prevent its introduction into marine gas turbines, where long life and reliability are essential. The brittleness of pure ceramics may be reduced by incorporating powdered metals in its manufacture, but for marine use metal blades will undoubtedly hold the field, at any rate, for some time to come.

Metals for gas turbine components must combine a variety of properties. They must, of course, retain a high strength, so that neither fracture nor excessive creep occurs at the high temperature employed. Turbine blades must be sufficiently tough to withstand considerable vibrational stresses, and in the open-cycle gas turbine the metal must be capable of withstanding the erosive action of the ash particles in the gas stream. Resistance to oxidation and scaling is also necessary, but fortunately most creep-resisting alloys are satisfactory in this respect, and no alloying elements need be added specifically for this purpose. Various components, such as the blades, rotor, and combustion-chamber liner of the open-cycle gas turbine, and the air-heater tubes of the closed-cycle gas turbine must withstand the corrosive action of the combustion gases. When heavy fuel oils containing appreciable quantities of sulphur are used, the corrosive attack may be serious on account of the tendency of nickel, a constituent of all the present heat-resisting metals, to react with the sulphurous gases to form the weak nickel sulphide. Special adjustments to the composition of the metal must be made on this account, and precautions in the design must be taken to reduce the occurrence of corrosion. It is also necessary that the metal be stable so that internal changes do not gradually occur at the high temperatures involved, resulting in changes of micro-structure, or reduction of creep strength and increase of brittleness. This also calls for the addition of small quantities of special elements to the alloy. With regard to manufacture it is important that the metal be uniform in quality, so that the results of tests on a few samples may with confidence be expected to apply generally. Finally, the metal must not be too difficult to fabricate, and must be suitable for casting, forging, machining, or welding, as required.

To obtain the required combination of properties is no easy matter, and the metallurgists are to be highly commended in having developed the alloys available to-day. It would not be profitable in this lecture to describe in any detail the composition and specific properties of these alloys. Those who are particularly interested in this matter would do best to refer to the papers presented by the metallurgists themselves. Although there is now much information on these alloys and certain theories have been developed about the effects of various specific elements on the general properties, the chemical and physical structures of these metals are so complex that much is still not understood, and further development remains almost entirely empirical.

Having described the basic principles of the gas turbine, and discussed in their simplest forms the different types now being developed, I should like to turn to the application of these plants to marine service and to consider particular installations.

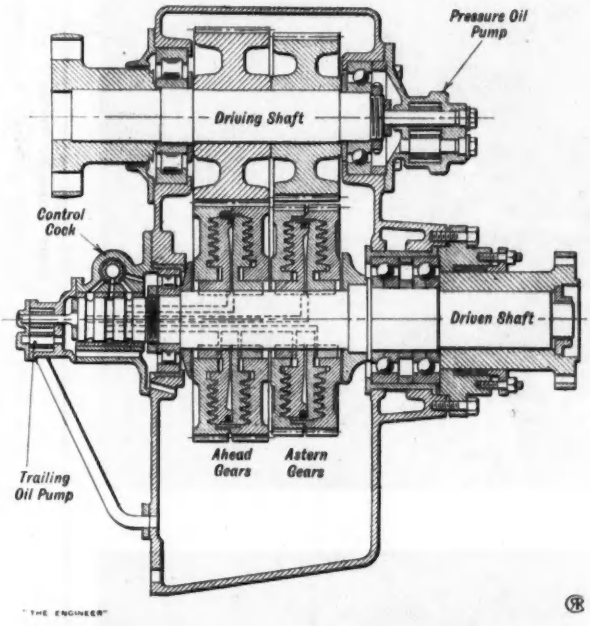


FIG. 9—OIL-OPERATED MARINE REVERSE REDUCTION GEAR

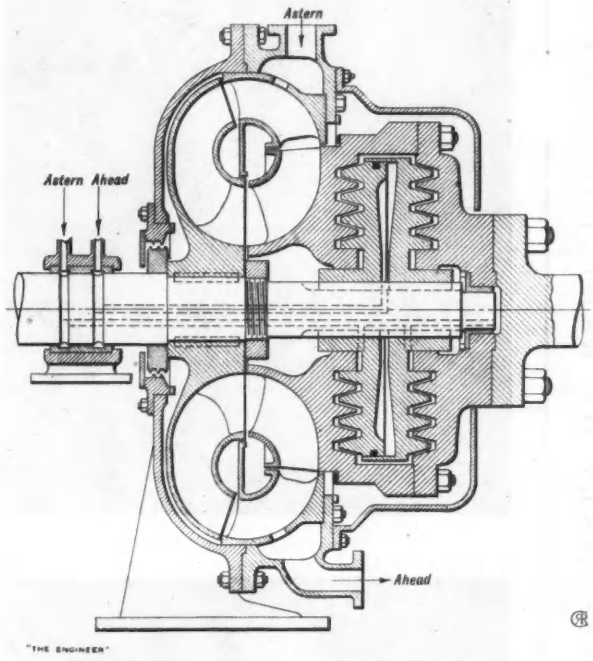


FIG. 10—HYDRAULIC REVERSING GEAR

ESSENTIALS FOR MARINE SERVICE

The essentials for marine service may be briefly stated. They are: (1) *reliability*; (2) long life; (3) low upkeep cost; (4) economy; (5) space occupied, and (6) weight.

Reliability.—I have put this requirement first and in italics because it is of the utmost importance for marine service. Most ships, except those designed for special services such as cross-channel vessels, must be capable of trading to any part of the world and must be capable of being maintained either by their own staff or by the very limited shore facilities which exist in some ports of the world. Also, it is not feasible in a ship to carry complete stand-by plant for the main propulsion machinery. A breakdown of the machinery may in an extreme case result in the total loss of the ship and its valuable cargo, as well as the lives of the crew. In other cases a breakdown at sea may mean very heavy costs for towing and salvage claims; if it occurs in harbour it means the whole ship is out of action, and may result in a financial loss, to the owners, of several thousands of pounds per day.

In view of the small number of moving parts required, it seems likely that the gas turbine should ultimately prove as reliable as the older forms of prime movers. This is specially the case with the closed-cycle gas turbine, because the turbines are operating on clean air.

Long Life.—It is the general practice to-day to design gas turbines for marine propulsion for a running life of not less than 100,000 hours at full load and temperature. This corresponds to a useful life of twenty to twenty-five years. The long life required, compared with the life of a few hundred hours for which aircraft gas turbines are designed, naturally involves working at lower temperatures and lower stresses. Owing to the advances which have been made in recent years in materials for use at high temperatures, it is now possible to design and produce a gas turbine to operate for 100,000 hours with a gas inlet temperature of 650 deg. Cent., or 1200 deg. Fah.

There is, however, a much greater degree of uncertainty concerning the behaviour of the high-temperature materials in a marine plant than in an aircraft gas turbine. It is quite practicable to run creep tests for a period equal to the whole life of an aircraft gas turbine, so that exact information can be obtained, and the turbine operated at temperatures and stresses which are only slightly lower than those which would cause failure during its lifetime. It is quite impossible, however, to run

MANUFACTURE AND ASSEMBLY OF RADIATOR CORES

Tube Loading Gear

Assembly Station and Separator Carrier

Fin Press and Feed Gear

Tube Nest and Assembly Station

creep tests for the 100,000 hours required by a marine plant, and in all probability, at the present rate of metallurgical development, the particular metal tested would be superseded by a superior alloy before the end of a long-time creep test, so that the information would be out of date before it was obtained. The marine designer must therefore base his calculations on data obtained by extrapolating creep curves based on tests of less than 10,000 hours, and must include a generous factor of safety to allow for possible errors in extrapolating more than ten times beyond the range of certain knowledge.

Low Upkeep Cost.—This feature is very closely associated with reliability, and in view of what has already been said about reliability it follows that, once the initial teething troubles have been overcome, the costs of repairs should compare favourably with other types of prime movers. In the case of the open-cycle gas turbine, there will be the cost of cleaning the heat exchanger and also possibly the turbine and compressor blading. In the case of the closed cycle, there will be the cost of cleaning the air heater, if this is required. Experience to date, however, indicates that, owing to the high metal temperature of the tubes, the complete combustion obtained and the high gas velocities used, these tubes keep clean indefinitely. At the worst, the cost of cleaning the air heater would compare favourably with the cost of boiler cleaning in a steam turbine installation, because only the gas side of the tubes would require cleaning.

Economy.—For a vessel of 5000–10,000 s.h.p. per shaft, a gas turbine can be constructed to have a fuel consumption of about 0·44–0·46 lb per s.h.p. per hour, corresponding to a thermal efficiency of 30–32 per cent, based on the gross or higher calorific value of the fuel. When developments in metallurgy allow us to increase the initial temperature of the air entering the turbine by a further 150 deg. to 1350 deg. Fah., the gas turbine fuel consumption will be reduced to about 0·38 lb per s.h.p. per hour, i.e., to approximately the same as the diesel engine.

With the open-cycle gas turbine it will probably be necessary to use a distillate fuel oil corresponding to a heavy diesel oil or a light boiler oil, in order to maintain cleanliness of the turbine, and heat exchanger. In the case of the closed-cycle gas turbine, however, it should be possible to burn any oils which can be burnt in a steam boiler, because the air heater is virtually an "air boiler."

In making a comparison of running costs, the consumption of lubricating oil should be taken into account. In this respect a gas turbine will compare favourably with a steam turbine, and will be very much more economical than a diesel engine. The cost of lubricating oil and cylinder oil in a marine diesel engine may amount to as much as 15 per cent of the cost of fuel oil, whereas in a corresponding steam or gas turbine the cost will only be about 0·5 per cent.

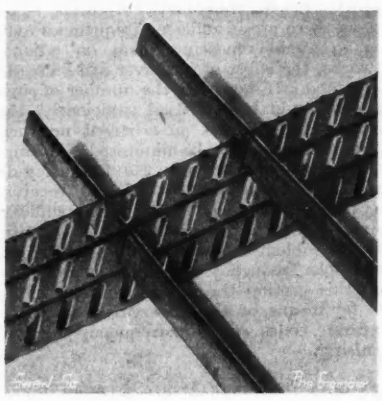
Space Occupied.—The space occupied by a gas turbine, including all the auxiliaries required both for main propulsion and ships' purposes, is less than that required for a modern steam turbine or diesel installation. It is impossible to give a typical figure for the saving in space, since it varies so greatly between the various classes of ship and the type of gas turbine. In a cargo vessel of 5000–10,000 s.h.p., however, a closed-cycle gas turbine would give a saving of about 25 per cent of the space required by a steam installation. An open-cycle gas turbine may be made very compact if a high efficiency is not required, so that inter-coolers can be dispensed with, and a small and low-efficiency heat exchanger is sufficient. On large ships, and particularly on passenger ships, however, the space saved by the simplicity and compactness of the actual plant may be more than compensated by the valuable space taken up by the large air-inlet and exhaust ducts, passing through all the decks. These ducts have to pass about five times the quantity of air and exhaust gas required by a similar steam, diesel or closed-cycle gas turbine installation, and, since pressure losses must be kept small, velocities cannot be high, and so the sectional areas must be large.

Weight.—The weight of a marine gas-turbine installation is considerably less than that of the corresponding steam or diesel plant, but again, as in the case of the space occupied, comparative figures can only be given for particular cases. The weight of a steam installation, including shafting, propellers, and all auxiliaries, may vary from about 220 lb per s.h.p., in a cargo vessel, where low fuel consumption is necessary, to about one-eighth of that figure in a naval vessel. The weight of a gas turbine also varies greatly according to the service for which it is required but, as an example, it may be stated that a closed-cycle installation in a 5000–10,000 s.h.p. cargo vessel would weigh a little over half the weight of a corresponding diesel installation, or about two-thirds that of a steam plant.

A Radiator Core Assembling Machine

WE have received details of an interesting machine which has been developed by the Ford Motor Company, Ltd., of Dagenham, for the assembly of motor-car radiator cores. With this machine it is stated that three men in nine and a half hours can assemble 330 radiator cores, with an appreciable reduction in costs and scrap wastage when compared with previous methods. The core of the Ford radiator consists of a number of copper strips or fins through which vertical water tubes are spaced in three rows. Prior to the introduction of the machine, the even spacing of the fins and the insertion of each tube through the series of fins without damage, involved the use of much hand labour and expensive equipment.

In the four principal operations which are combined in the one machine, the fins are made and then stacked in correct position,



FINS AND TUBES

properly spaced, in sets of 111; the tubes are arranged and put into position ready for insertion into the fins, and finally the tubes are pushed into place in the fins to complete a radiator core. It consists of three main units, having a fin-making unit on one side and a tube positioning unit on the other side of a centrally disposed core assembly unit. The sequence of operations can be followed by reference to the photographs we reproduce on page 158.

The fins are made from copper strip on a standard design of power press on one side of the machine. Here the fins are formed, cut off to length, and then fed between two moving belts running face-to-face and leading to the central assembly unit. As each fin passes between the two belts it actuates a lever resting on a ball bearing roller on the top belt. This lever serves to actuate a series of hydraulic valves, which automatically control the operating sequence of the machine.

The belts carry the fins upwards and forwards and deliver them on to a stack on one side of the main body of the machine. Here, in order to maintain regular spacing between the fins in subsequent operations, a spacer bar is automatically dropped into place on each successive fin as the stack is built up. These spacing bars are stored in a magazine projecting at right angles from the front of the machine at the head of the stack. A bar is fed from the magazine on to the stack, by the operation of the trip lever on the feed belt, every time a fin passes up from the press. As each fin and spacer bar is dropped on to the stack a platform on which the stack is resting, lowers the stack an equivalent height. A ratchet lever and rack mechanism which operates to lower the platform is also actuated by the lever in the fin feed belt. When 111 fins have been built up with their spacing bars the feed mechanism and the press are automatically stopped by the action of a limit switch operated by the platform.

Whilst the making and stacking of fins is in progress at one side of the machine, the tubes are being handled on the opposite side. The tube mechanism is designed to assemble the requisite number of tubes, spaced out in a nest and to place them bodily in a vertical plane opposite the holes in a stack of fins.

Tubes of appropriate length are first laid horizontally in a hopper (see illustration) where they gravitate into slots. A set of fingers on a travelling carriage at the bottom of the hopper pushes each line of tubes lying in the slots forwards into a transfer carriage set in line with the front of the hopper. This transfer carriage takes three rows of tubes corresponding to the three rows in each radiator core and after each individual row is filled the carriage is automatically lowered a proportionate distance for the loading of the next row.

The transfer carriage is mounted on a trunnion on which it can be swung from the horizontal to the vertical plane. When in the vertical plane it can then be swung about a supporting pillar, away from the hopper unit, to lie at the centre of the front of the machine. When it is fully loaded the carriage is swung down into a vertical position and the set of tubes in it rest on a retaining shutter on an extension of the carriage. The carriage with its load is then swung across into position at the front of the machine and the retaining shutter withdrawn. The set of tubes so released drops down into a nest at the base of the machine, and the transfer carriage is returned for refilling.

A hydraulic ram then pushes the stack of fins and separators into position with their holes registering over the set of tubes, and the stack is automatically clamped down from the top by another ram. As the stack feeding

ram then retracts it automatically starts the press and the making and stacking of another series of fins begins. Whilst the next set of fins and tubes is being prepared a ram carrying a series of long ejector rods pushes the tubes in the central nest upwards through the holes in the fins to complete the radiator core.

At the end of its ejection stroke the tube insertion ram retracts, leaving the core assembled but still under compression and having the spacers still set between the fins. To remove the spacers the special carrier clamping fixture illustrated on page 156 is used. This fixture is suspended from an air hoist and on being placed over the radiator core held in the machine it clamps itself on the whole body of spacers. Four push rods, actuated by a hydraulic ram from the rear of the machine, then eject the separators from the core, and the carrier with the separators attached is swung clear. The radiator core is then released and removed, whilst the separators are transferred *en masse* from the carrier to their feed magazine, ready for use in building subsequent stacks of fins.

At the main control position of the machine signal lamps are used to indicate the completion of the various stages such as the completion of a stack of fins, the beginning and end of the working stroke of the principal hydraulic ram, &c.

Centralised Ripple Control on High-Voltage Networks*

By T. W. ROSS, M.I.E.E.,† and R. M. A. SMITH, B.Sc.(Eng.), A.M.I.E.E.†

THE term "ripple control" is used in this country to describe remote control by alternating currents of audio frequency which are superimposed on power networks. The term serves to distinguish such systems from other forms of superimposed remote control in which either direct current or alternating current at radio frequency is used. The latter, known as "carrier current," is perhaps more widely used for telephony or protective gear than for control purposes, and its application is practicable only where the power networks consist entirely of overhead lines and without intervening power transformers. Remote control by direct current is practicable only when applied to the low-voltage a.c. networks, and is thus of the local type not dealt with in the paper.

Although ripple control was introduced in the early part of the century, it is only during the past ten years that its application to large h.v. networks has been seriously considered, and it seems an opportune time to review the progress that has been made.

If remote control by superimposed current is to be of the centralised type generally applicable to h.v. power networks, it must be essentially by alternating current at a frequency which differs from the power frequency, so that it can be easily distinguished therefrom. The frequency must also be such that the control currents can be transmitted throughout the network and transformed through the power transformers without excessive losses. A band of frequencies in the audio range has, in general, been found to answer the purpose, and with few exceptions can be applied to any power network, however constituted.

Whilst the average h.v. network lends itself very well to the propagation of audio-frequency currents, it is desirable initially to check that the distribution of the current throughout the network will be such that usable signals will be available at any point on the l.v. system. During the early days of ripple control the check was made experimentally prior to designing the injection equipment, but as the art progressed formulæ for checking by calculation were developed. It is now possible to determine within a reasonable degree of accuracy the ripple impedance of all branches of a network, together with the attenuation and other losses, and so obviate the necessity for an experimental check. The formulæ which were built up from information obtained by experimental analysis on many networks have proved of much value when considering new projects. The more important aspects of the subject are discussed in this paper.

In the application of superimposed control to h.v. networks the method by which the signal currents are injected is perhaps the major problem. The original scheme was to inject the ripple current in series with parts of the network, one at a time, and to use the remainder together with any interconnected networks, as the return path for the current. As this method is costly and very often difficult to apply in practice, it is now more usual to inject in parallel with the whole network. The problem is largely one of economics concerned with (*a*) the means of access to the network at the central station; (*b*) the protection of the injection equipment with due regard to the safety of the power plant and (*c*) the size of the injection equipment.

Considerable attention has been given recently to parallel-injection methods, and improvements have been made whereby the size of the equipment has been reduced. The improvements, described later, are chiefly in relation to the power lost in the tuned coupling circuit, which was responsible for the bulk of the power required from the ripple generator. For instance, an inefficient coupling circuit may account for 98 per cent of the ripple power generated for signal purposes.

Almost all electricity supply networks in this country are interconnected with the networks of other undertakings either directly or through the national Grid and this, from the standpoint of ripple control, has the disadvantage that some of the control current can flow into the other networks. This "spill-over," as it has been termed, not only involves a loss of signal current, but may cause interference with the sending of signals or with the ripple relays on those other networks, particularly if the same, or similar, frequencies are used on more than one network. As it is not practicable to avoid some spill-over, steps must be taken to prevent signal interference between interconnected networks.

A common practice has been to employ a separate ripple frequency for each signal, but, as there are insufficient frequencies available to avoid repeating them on adjacent networks, the effect of spill-over can be readily understood. If, however, the number of signal channels could be increased sufficiently, they need not be repeated on adjacent networks, and interference would be minimised. Attempts to do this by improving the frequency-discriminating characteristics of the receiving relays have so far failed to provide for sufficient signals to meet the requirements in this country, but the problem has been solved by using only one ripple frequency for each network and from this getting the desired number of signals by means of time-interval codes, pulse-counting codes or low-frequency periodic impulsing.

Economics of Centralised Ripple Control

Perhaps the most profitable use to which centralised ripple control can be put is in the control of off-peak loads, particularly in the domestic field. It is well-known in electricity supply circles that the domestic load factor is a particularly poor one and, moreover, that the incidence of its peak is usually at an inopportune time with respect to other classes of load. One method of improving the load factor is to encourage the use of off-peak electricity for water heating, and in some countries much has been done in this direction. Time switches have been largely used as a means of controlling such off-peak loads, but owing to the incidence of the network peak changing from day to day, it has become difficult to arrange for an optimum setting for the time switches, and ripple control has been installed, or is now being considered. As an instance of this, many Canadian supply authorities sell electricity for domestic-water heating at a fixed sum per kilowatt installed and control it by ripple relays for off-peak use. This service is popular with the consumer and profitable to the supply authorities and it has considerably improved the domestic load factor. It has been stated by supply engineers that water heaters are the best unit consumers in the domestic field, and provided these units do not increase the maximum demand on the supply system they are a profitable source of revenue, so much so that the cost of off-peak load control can be very well justified. If, for example, the maximum-demand cost increment per kilowatt is £3 10s., every 3kW heater represents a minimum potential addition of £10 10s. to the demand charges at peak load. Such a heater would consume on the average, say, 4000 to 5000 units per annum, equivalent to £8 to £10 in revenue, which at off-peak time would be a desirable contribution to the domestic load factor and to the profits of the supply authority. The amount of money which could be invested in ripple control for this purpose is debatable, but it seems reasonable to suggest at least £8 installed cost per water heater, which should include a proportion of the cost of the injection equipment, depending upon the total number of relays installed. The cost of the injection equipment varies owing to factors already discussed and to the kilowatt capacity and demand of the network and load, so that it is difficult to assess it in average monetary values.

Although the water heater is the only part of the domestic load which at present is looked upon as suitable for off-peak control, it is the space-heating part of the load which often creates the highest peaks. These peaks frequently occur at times when other loads are also at peak value, and if the space-heating load could be regulated it would greatly assist in reducing the maximum demand. There are many difficulties in the way of such regulation, but certain lines of approach have already been suggested and if a practicable scheme can be developed then ripple control could be used in another very profitable direction. The chief difficulty in reducing the space-heating load is the impracticability from the consumers' viewpoint of entirely disconnecting space heaters at times of peak load, but it seems reasonably practicable to reduce the energy consumed per heater at such times. One way of doing this is to lower the voltage by means of a tapped auto-transformer under the control of a ripple signal. The secondary part of the auto-transformer would be connected in series with the power or heating circuits of each domestic consumer and could conveniently be rated at, say, 10 per cent of the installed capacity. They would give 20 per cent reduction of the heating load without serious inconvenience to the consumer, but with distinct advantage in reducing the maximum demand.

The convenience of remote control for street lighting, shop-window lighting, &c., is so obvious that it is not necessary to elaborate on it, but only to point out that centralised ripple control provides the means for doing this in addition to the more profitable off-peak load control.

Conclusion

Centralised ripple control provides a very useful appendage to a distribution network and gives the supply engineer a means whereby he can control the supply to consuming devices. It will be apparent from the paper that the technical problems associated with the introduction of such control schemes are chiefly concerned with the distribution network itself and its interconnection with other networks. This is quite understandable since the primary purpose of the network is for power transmission and not for signal transmission. It has, however, been clearly demonstrated that ripple control can be applied to public supply networks with satisfactory results and, it is suggested, with decided economic advantages. The fact that so many of the networks in this country are interconnected makes it necessary to provide for an increasing number of signal channels, and with the present state of the art the practical limitations in this direction are well defined. Each equipment can conveniently cater for twelve separate signals, and it is anticipated that this number is ample for the reasonable needs of any one network.

* Institution of Electrical Engineers, Transmission Section. London, February, 11th. Abstract.

† Metropolitan-Vickers Electrical Company, Ltd.

Some Mechanical Features in Anti-Submarine Weapons*

By J. M. KIRKBY, M.A., A.M.I.Mech.E.†

THE depth charge (Fig. 1) has remained substantially unaltered in form since its inception. It is essentially a cylinder of ¼in steel plate, 18in in diameter and 26in long, containing some 300 lb of explosive; a central tube is fitted to hold the firing mechanism, which consists of pistol and primer. The pistol operates when a head of 50ft has been built up in the primer tube; the rate of water entry can be controlled by bringing into action (by rotating an external handle) one of a series of orifices, the effect of which is to delay the building up of pressure in the tube and so to increase the time—and therefore, in normal circumstances, the depth—at which the 50ft head is reached. The primer is coupled to a device termed the primer placer, which permits a 3in axial movement of the primer while retaining complete watertightness of the tube.

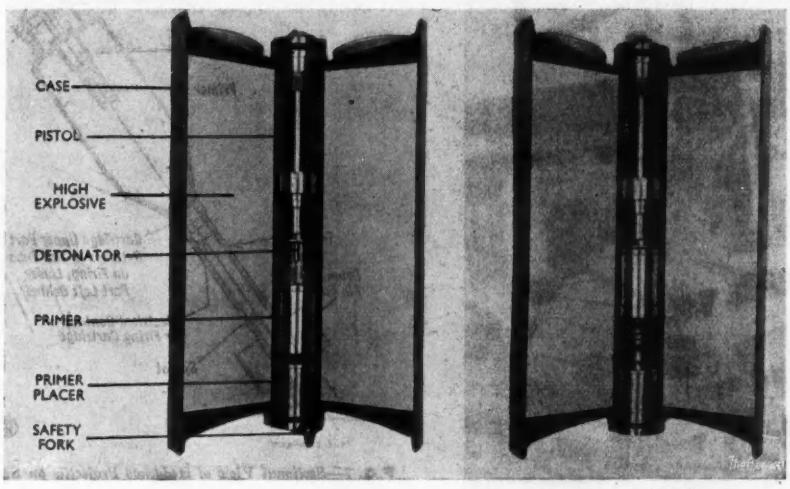


FIG. 1—*Sectioned Depth Charge in Safe and Armed Condition*

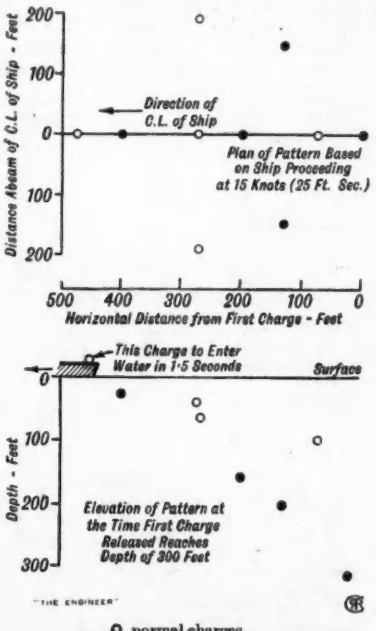
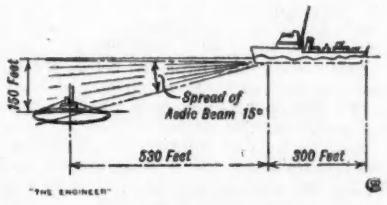


FIG. 2—*Plan and Elevation of Depth Charge Pattern*

The damage produced under water by an explosive charge can be regarded as proportional to the square root of the charge weight W, and inversely proportional to the target charge distance; lethal damage to a submarine (i.e., rupture of a ¾in thick pressure hull) will be caused by the explosion of 300 lb T.N.T. at a distance of 21ft. The distance at which lethal damage will be produced is therefore proportonal to $W^{\frac{1}{2}}$, but as this distance extends in all directions round the charge, the lethal volume is proportional to $W^{\frac{3}{2}}$. To render a given volume of sea lethal to a submarine, it is clearly advantageous to employ charges of the largest practicable size. This argument, however, neglects the finite size of the submarine, since it is only necessary for any one portion of the submarine to be within the lethal volume; it is therefore preferable to distribute the charges in plan and elevation. The actual distribution used in service, termed a "pattern," is a compromise governed partly by theoretical "probability" calculations and partly by practical considerations of the safety of the laying ship, available charges, handling facilities, &c. A pattern consists of two layers, each of five charges, the distribution in plan being obtained by rolling three charges from the stern at intervals as the ship proceeds, and discharging one to each side from mortars (termed "throwers"); the distribution in depth is obtained by discharging slightly earlier in time a similar pattern, the charges of which are ballasted to give them a higher sinking speed (see Fig. 2). These ballasted charges are set to fire 100ft to 150ft deeper than the normal charges. For simplicity of drill, the pattern is time-spaced, so that the actual spacing depends on the ship's speed (usually about 15 knots).



Distances are typical only.

FIG. 3—*Diagram Showing Distance at which Attacking Ship has Asdic Contact with Submarine*

The normal charge sinks with its axis horizontal, the terminal velocity being 10ft per second. The ballast weight for the faster sinking charge is secured to one end, and by giving the charge an axis-vertical attitude, as well as by increasing the weight, the sinking speed is increased to 17ft per second. The shape of the ballast weight was determined by the consideration that its presence must not interfere with the handling of the depth charge in existing equipment, so that the speed of 17ft per second represents what could be achieved in practice rather than any thoeretically desirable speed.

Method of Making an Attack.—To understand what performance is required of a shipborne anti-submarine weapon, it is necessary to have some slight knowledge of how an attack on a submarine is made. Assuming that a submarine has been located in the asdic beam, the ship's captain endeavours to con the ship so that its stern can be brought over the spot where it is estimated the submarine will be by the time the charges have reached it. The depression of the asdic beam is, however, fixed at a comparatively small angle, so that the submarine passes out of the cognisance of the attacking ship at a range less than about three times the depth of the submarine (see Fig. 3). Even under favourable conditions some thirty seconds must elapse from the time contact is lost with the submarine until the depth charges are discharged; to this must be added the time of sinking of the charges to their exploding depth, which in the case of a submarine at a depth of 200ft may be another fifteen to twenty seconds.

It will be clear that after the elapse of this length of time there must be considerable uncertainty of the exact position of the submarine in plan due not only to the instrumental and human errors in estimating the course and speed of the submarine from asdic data while the ship was in contact, but also to the evasive action on the part of the submarine commander. It is to allow for this uncertainty that the pattern plan is made as large as possible.

This long "blind time" (i.e., time from loss of asdic contact to explosion of depth charges) was not a very serious defect in the stern-drop method of attack, so long as submarines had comparatively slow underwater speeds (e.g., 6 knots maximum) and were likely to be encountered at depths not exceeding 200ft; this was roughly the state of affairs in the period between the wars. With the improvement in the ability of submarines to withstand punishment, and with their ability to dive to greater depths, a material decrease in the blind time became a necessity if attacks were to be effective, and an obvious step in this direction was to increase the sinking speed of the weapon. This, however, was not possible with depth charges, as will be seen from a consideration of the effects of the explosions on the attacking ship. The first place in a ship to suffer damage from an underwater explosion is the engine-room, where the mountings of heavy pieces of machinery are likely to be broken, although steps have been taken to introduce as far as possible resilient mountings to minimise shock effects. The criterion for the safety of the attacking ship thus becomes the distance of the

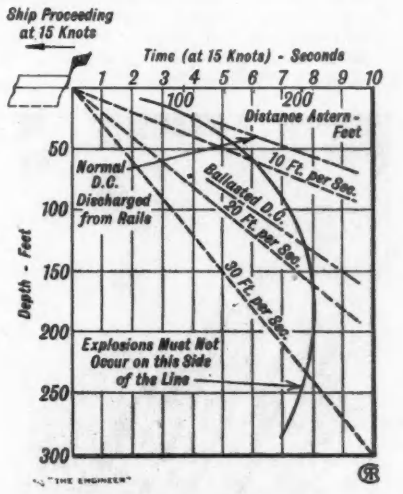


FIG. 4—*Diagram Showing Minimum Distance Astern and Depth for Explosions not to Damage Attacking Ship*

* Institution of Mechanical Engineers, February 6th —Abstract.

† Principal Scientific Officer, Admiralty Mining Establishment.

explosion from the after engine-room bulkhead, and for charges of 300 lb of T.N.T. the distance closer than which explosions cannot be permitted to occur is shown diagrammatically in Fig. 4.

The explanation of the rapid reduction in range at depths shallower than 100ft is that

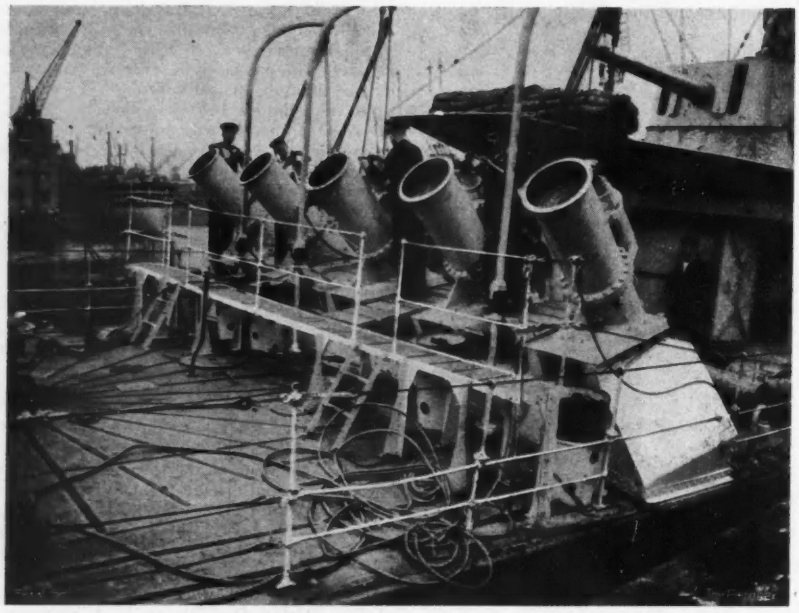


FIG. 5—*Battery of Forward-Firing Throwers Mounted on Forecastle of H.M.S. "Whitehall"*

when a charge explodes close to the surface the path traversed between explosion and ship by the shock wave reflected at the surface is only very slightly longer than the direct path. The reflected wave will therefore arrive while the direct wave is still present, but as the reflected wave has suffered reversal in phase at the surface, it is—in effect—a tension wave; the

View taken before end covers were fitted to bearings.

FIG. 6—*Hedgehog Mounting Trained to Starboard*

tension will cancel any compression due to the direct wave, and so will reduce the effect of the latter. The increase in range below 250ft is due to the fact that the projected area of the ship's bottom normal to the line of propagation of the shock wave is increasing.

On the diagram in Fig. 4 are also plotted depth-time curves for various sinking speeds based on an assumed ship's speed of 15 knots, and it will be seen that if explosions are required at a depth of 50ft—as they obviously must be for attacking shallow submarines—a sinking speed much in excess of 10ft per second is not permissible. Since a slow sinking weapon is unavoidable for attacking shallow targets, and a fast sinking weapon desirable for attacking deep targets, the only solution would be to carry both forms—a solution that is unacceptable in view of the complication arising from the necessity for having magazine facilities and discharge gear appropriate to both forms. The possibility of fitting the fast sinking weapon with a drogue, or other means of reducing its speed, when required for a shallow attack, is ruled out by safety considerations, as failure of the speed-reducing device to work might well result in damage to the ship.

Weapon Discharged Ahead.—If the weapons could be discharged ahead, not only would the blind time be reduced to the sum of the time of flight in air and time of sinking through the water, but a high sinking speed would also be advantageous, since for the safety of the ship the charges must have exploded before she has approached too near. It would be possible to project depth charges ahead, in which case the range would require to be 350 yards, which would call for a thrust of 90 tons. Such a thrust would require a considerable amount of deck stiffening, and this scheme was only adopted in two ships, a photograph of the armament of one of which appears in Fig. 5.

An alternative was to project ahead small charges to explode only on contact with the submarine, and to compensate for the small likelihood of a direct hit by any one charge by employing a large salvo. Trials showed that the weight of explosive to rupture the pressure hull of a submarine when the charge is exploded in contact with the casing 4ft above it is 30 lb if the most efficient explosive available is used.

The use of contact fired charges has the following further advantages:—

(*a*) Their operation is independent of the depth of the submarine.

(*b*) The explosion of one or more charges should (at least in theory) indicate a "kill."

(*c*) The water is not disturbed by large explosions which, until the disturbance is dissipated, tend to prevent effective use of the asdic.

The chief defect in a contact-fired charge is that in the absence of a target it is not possible to produce an explosion. There are occasions when an explosion, even if not immediately endangering a submarine, may deflect its commander from any course of action he is pursuing at that moment, such as preparing to fire torpedoes at a convoy. Another objection—it cannot be called a defect—is that a submarine destroyed by this type of charge often leaves no evidence of its destruction behind it; this rendered the weapon that was developed on the foregoing lines a little unpopular with the commanders of some escort vessels, since to establish a kill the Admiralty were insistent on visible evidence in the form of recovered clothing,

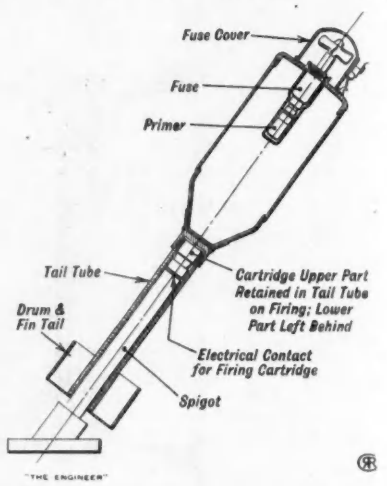


FIG. 7—*Sectional View of Hedgehog Projectile on Spigot*

lockers and other debris that floated to the surface after the destruction of a submarine.

The "Hedgehog."—A weapon on the above lines was developed during the war and brought into service at the end of 1941. The projectiles were fired from spigots, and the appearance of the spigot mounting gave the weapon the name "Hedgehog"—very appropriately, as can be seen from the view given in Fig. 6. The projectile weighed 62 lb and contained 34 lb of the explosive known as "Torpex"; the rate of sinking was 24ft per second. A salvo consisted

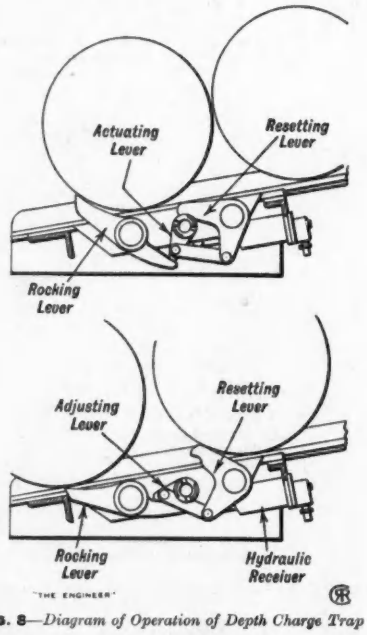


FIG. 8—*Diagram of Operation of Depth Charge Trap*

of twenty-four projectiles fired to produce a pattern in the form of a circle 130ft in diameter, the mean range of projection being 200 yards.

The variations in range and angle to produce the pattern are obtained by suitably aligning the spigots in elevation and bearing, the same weight of propellant charge being used for all projectiles.

A sectional view of the projectile on its spigot is given in Fig. 7. One feature of interest is that the tail vanes are set in a helix of approximately 19ft pitch, so as to impart a spin to the

projectile when in the water. The object of this is to reduce dispersion due to any slight asymmetry in the manufacture of the tail. Without spin, such asymmetry can lead to the projectile wandering farther and farther from its true path as it descends; with spin, the asymmetry will cause the projectile to pursue a spiral path in which the departure from the true path is constant for all depths.

It can be shown by calculation that, for attacks on a submarine at depths from 0 to 300ft, the probability of inflicting lethal damage to a submarine with "Hedgehog" is about three times that with depth charges. In practice, the ratio of probabilities is rather better than this, in favour of the "Hedgehog"; the reason for this lies chiefly in the difficulty of conning a ship so as to place its stern at the desired spot—a practical point which has to be neglected in computing probabilities. Not only is this difficulty avoided in using the "Hedgehog," but as the mounting of the latter has to be stabilised to neutralise the effects of roll, it is possible, by deliberately inclining the spigots, to fire over an arc extending to some ± 30 deg. from the centre line of the ship; it is consequently only necessary to keep the spigots directed at the target and not the centre line of the ship.

Nevertheless, the depth charge played an important part as an anti-submarine weapon, for out of the total number of German U-boats known to have been sunk by British surface forces some 75 per cent were destroyed by depth charges. It should be remembered, however, that for the first two years of the war there was no other shipborne weapon available.‡

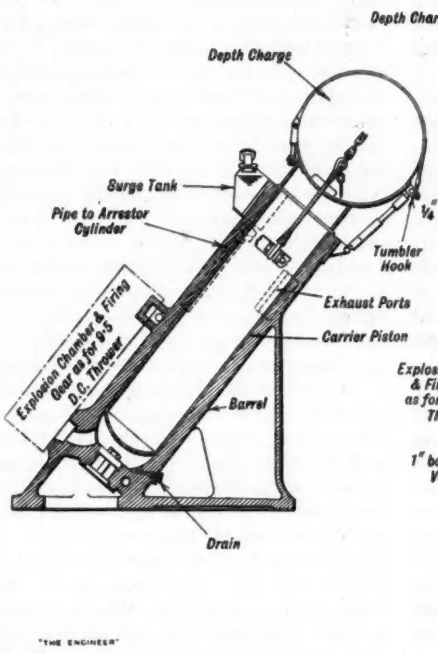


FIG. 9—*Sectional View of Depth Charge Thrower*

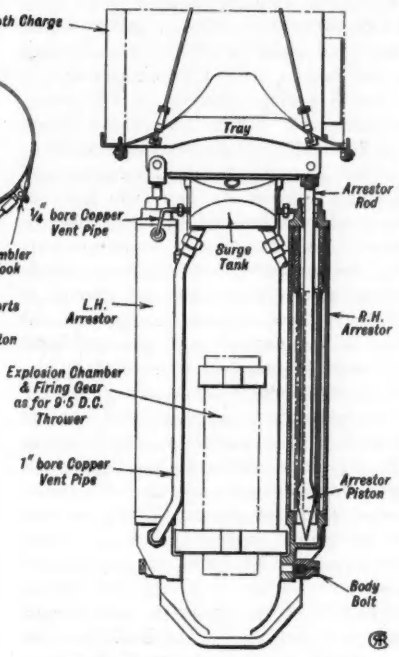


FIG. 10—*Section Through Arrestor Cylinder*

Weapon Discharge Gear

Mechanical features of general interest are rather lacking in the weapons themselves; the discharge arrangements for the weapons, however, provide several features of interest in mechanical design and these are described in some detail.

Depth Charge Traps.—As already stated, depth charges are placed by being either rolled over the stern or projected on the beam. For stern release, charges are rolled down an angle-iron structure having a 10 deg. slope, a guard rail being fitted at the top to prevent the charges jumping the release levers or being lifted by the action of heavy seas. To release a charge and bring the next charge to the ready position, a device termed a "trap" is employed; this is illustrated in Fig. 8, and one essential feature of the arrangement is to ensure that only one charge can be released at a time. To operate the trap, the shaft carrying the actuating lever is rotated clockwise (as drawn); the weight of the ready charge then depresses the rocking lever and the charge rolls out. The same action has resulted in lifting the toe of the resetting lever, thus restraining the next charge from moving. On releasing the shaft, the weight of the standby charge forces down the resetting lever, which action restores the rocking lever to its safe position; the standby charge is thereby free to roll into the ready position. To ensure that the charges do not jam between the toes of the levers and the top rail, the gauge between top and bottom rail is toleranced to $+\frac{1}{8} - \frac{1}{16}$; this is fairly close for a fabricated structure, and calls for accurate manufacture. The "working" of a ship can alter the dimensions, so that a periodical check must be made while the ship is at sea. Freedom of movement of the working parts is of vital importance, and the design requires careful consideration when the gear is exposed to the corrosive action of sea air and sea water such as can occur in the stern of a small ship. The levers are made of steel plate, and bushed with gunmetal, the journals being naval brass, and this combination, coupled with lubrication by grease gun using anti-freezing grease, has been found satisfactory.

Depth Charge Throwers.—Unlike most other cylindrical shaped weapons, the depth charge is projected with its axis transverse to the barrel of the mortar. The depth charge is therefore carried on a semi-circular tray secured to a piston, as shown in Fig. 9. To prevent loss of piston and tray, arrangements are made to arrest the motion of these towards the end of the stroke by means of the arrestor cylinders mounted on each side of the barrel (see Fig. 10); the ports in the arrestor are arranged to give as nearly as possible a uniform deceleration. Just before the arrestor piston enters its cylinder, the end of the piston reaches the exhaust ports in the barrel. The depth charge is projected 67 yards, the axial reaction being approximately 25 tons. The fluid employed is a mixture of glycerine and lime water in equal proportions by volume, the lime being added to neutralise any acid in the glycerine.

The charge is secured to the tray by means of the strop and tumbler hook, as shown in Fig. 9. The initial motion of the piston results in the spigot of the tumbler hook being withdrawn from the sleeve attached to the barrel, thus freeing the charge.

The cartridge is fitted in an explosive chamber attached to the barrel and is fired by means of a spring-loaded striker. The striker is lifted against the pressure of the spring by a wedge until—when the wedge is completely withdrawn—the striker is released.

Experience in the 1939–45 war showed the necessity for guarding against the non-operation of traps and throwers due to accumulations of ice and snow. It was found necessary to enclose rails and throwers as far as possible with steel and canvas covers to prevent large accumulations, and to run steam heating coils in suitable locations to keep the working parts free.

(To be continued)

‡ In the above account it will doubtless be realised that for security reasons a great deal has of necessity been left unsaid. Some obvious improvements or alternatives will suggest themselves, and it can be admitted that by the end of the war better equipment, better weapons, and a better technique were in service use; at the same time, the position described represents very fairly the conditions under which anti-submarine warfare was waged for the first half of the war—a period which covers the major portion of the Battle of the Atlantic.

Submarine Gravity Survey in the English Channel

The Admiralty has stated that the Department of Geodesy and Geophysics at Cambridge University is to make a gravity survey on board H.M. Submarine "Talent" in the English Channel during May next. The project is being sponsored by the Royal Society with the full co-operation of the Royal Navy, and the object of the expedition is to obtain information about the structure of the channel basin which should help in interpreting how the geology of Southern England is related to that of the Continent. The cruise will last for four weeks and will cover the area between England and France from Plymouth to Hastings. H.M. Submarine "Talent" will be manned by her normal complement of officers and men of the Royal Navy, but three civilian scientists, Mr. B. C. Browne, Mr. R. I. B. Cooper and Mr. R. L. G. Gilbert, will also be on board. She will be equipped with special apparatus, some of which has been lent by the Danish Geodetic Commission. It is pointed out that accurate measurement of this kind can only be made under very steady conditions, and the movement of a surface vessel would render it impossible to make the necessary observations except in a dead calm. A submarine, however, can dive below the waves and even in rough weather at a depth of 100ft to 200ft the boat is so steady that measurements can be made at sea almost as accurately as on land. This method of working was originally devised by the Dutch scientist, Professor F. A. Vening Meinesz, and has been used by him to make over a thousand gravity measurements all over the oceans. The work has also been carried on by the U.S.A., France, Italy, Russia and Japan, and has recently been taken up in this country. A British expedition in August, 1946, on board H.M.S. "Tudor," surveyed an area from the north coast of Spain to the Rockall Bank. Besides valuable scientific results, the experience gained showed how the apparatus and technique might be improved. The forthcoming survey in the Channel will provide an opportunity of testing out these new ideas, as well as throwing light on the geological structure and history of the English Channel.

Henry Ford's Visit to England.—Mr. Henry Ford is paying a visit to this country and arrived this week. At a press conference he stated that 6000 British Ford cars and vans are to be exported to the United States, to a total value of £1,125,000, to earn dollars. Growing traffic congestion in America, Mr. Ford said, was tending to favour the small car, and he felt that the small British car, particularly sports cars, would find a market, as no equivalent type of vehicle was manufactured there.

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WAGES AND ECONOMICS

How weary we are all becoming of economic discussion! Yet tired though we may be of the subject it is still true that the economic state of the country is dictating many of the Government's actions; and judged economically such a statement as that upon Personal Incomes, Costs and Prices, made by the Prime Minister in the House last week was, in fact, long overdue. For though, as Mr. Attlee said, "high direct taxation on personal incomes and on distributed profits has curtailed the amount of profits available for spending and has thus helped to check the danger of inflation from personal incomes derived from investments, rents and profits," there has been no corresponding regulation of the purchasing power of wages except through the influence of trades union leaders in restraining the demands of their followers for higher pay. The restraint thus exercised was, indeed, partially effective during the first six months of last year. Even so, it cannot be claimed, we think, that productivity rose sufficiently in a period that included the months affected by the fuel crisis really to justify the aggregate net increase in weekly full-time rates of wages of about £300,000 that in fact occurred. But in the last six months of the year restraint was far less apparent. During that period wage agreements permitted an increase of no less than £1,400,000 in weekly full-time wage rates, and the total increase during the year of £1,700,000 per week affecting nearly five million workpeople is clearly quite out of accord with a period in which there was little or no change in the quantity of goods available to be purchased on the home market, whatever increase there may have been in total output. Whilst the inflationary effects of increases granted in 1947 are already becoming apparent, yet further claims affecting important industries, including shipbuilding and engineering, are still pending. Clearly a halt must be called to such a process, for, to quote that sentence from the "Statement on the Economic Considerations affecting relations between Employers and Workers" that Mr. Attlee himself quoted, "if costs of production and in consequence prices rise in relation to world prices it may make it impossible for us to pay our way in the world and buy all the imports we need."

The necessity for calling a halt to wage increases was made all the clearer by the issue last Tuesday of a White Paper on the "United Kingdom Balance of Payments, 1946 and 1947." For that White Paper reveals markedly the grave economic situation of this country. We can for only a very little longer continue to buy from the rest of the world more than we sell to it. Bluntly the standard of living that we are now experiencing, wage-earners, salary-earners, landlords and industrialists alike, low though it may seem (especially to the professional classes) in comparison with pre-war days, is still much higher than is justified by the quantity of goods that we are producing and the international services that we are performing. It is difficult to be precise as to the degree to which we are dependent, in order to maintain our standards, upon the expenditure of reserves and upon the piling up of debt overseas. For the visible import and export figures showing an adverse balance now running at a rate probably in excess of £50,000,000 per month do not reveal the whole of the deficit. In 1947 invisible items—shipping, interest and profit on foreign investments and so forth—when set off against military expenditure abroad, relief and rehabilitation, our share of the cost of running Germany, &c., still left a deficit for the year of £226,000,000, as compared with a surplus of £232,000,000 in 1938. Thus, some indeterminate allowance for the loss on "invisible" items must be added to the figure of about £50,000,000 per month to arrive at that true monthly adverse balance which constitutes a measure of the excess of our standard of living above that really justified by our productivity. Such a condition cannot persist for long. Either our exports must rise substantially or our imports of food and raw materials must be cut. So urgent, indeed, has the need to balance our oversea accounts become that during the last few months certain goods that were formerly reaching the home market have been diverted to exports, whilst the 1947 figures in the White Paper reveal also that total imports reaching the home market fell from £179,000,000 in July to £153,000,000 in December. No doubt that reduction of imports will continue in 1948. The downward trend in goods reaching the home market seems therefore likely to persist. For the bulk of the increased output from industry that we hope will be forthcoming in the next few months must go to export. It cannot be allowed to reach the home market until such time as a balance is achieved in our overseas trade. It follows that until that balance is attained our real standards of living are unalterable upwards, whatever may happen to personal incomes, and are in fact more likely to decline than to remain stable. Any general increase of personal incomes can in such circumstances only lead to a corresponding increase in price—that is, to inflation—whilst an attempt to protect wage-earners alone from the economic effects of our situation by raising wages could only depress further the standards of living of the professional classes. Those classes, amongst whom the great bulk of engineers, of course, are numbered, are already bearing in substantially lowered standards the brunt of our post-war economic difficulties. They cannot be called upon to carry more.

These arguments are, of course, by now so well worn and so obviously sound that we find it incredible that the leaders of the trades unions should not appreciate their force. Yet it must be allowed that those leaders are being asked relatively suddenly, even if only for a short-term period, almost to reverse their traditional policy of squeezing out of industry ever greater returns for their members, and they are being asked to do so at a time when owing to the existence of a sellers' market, to which increased costs can be passed on, industry has been proving less resistant than usual to their claims. It is never easy gracefully to complete a *volte-face*. Yet we hope that not all trade union leaders will come to the barren and depressing conclusion of the Executive Council of the Union of Shop Distributive and Allied Workers that "to freeze wages while the cost of living continues to rise would only lead to acute industrial disturbances." The publication of the White Paper so soon after Mr. Attlee's statement in the House may do much to drive home both to trade union leaders and their followers the essential need for restraint in pressing wage claims. For in reality the amount of money in our pockets has no relation to our living standards. The latter are fixed by our rate of production and only through a substantial rise in that rate can we hope in the future to see standards of living once more rising steadily as they did in the past. The T.U.C. horse, however much it may desire to see workers' standards rise, is, as Low represented it in the *Evening Standard* last Tuesday, faced by an economic stone wall.

ENGINEERS AND WARTIME ACHIEVEMENTS

SINCE the war ended a remarkable series of lectures and papers has been presented before engineering institutions and societies in this country upon wartime subjects. At the Institution of Mechanical Engineers those lectures and papers, one of them a talk before an informal meeting, have dealt with the general work of scientists during the war, the development of the Whittle jet propulsion gas turbine and of gas turbines in general, the disposal of unexploded enemy bombs, the evolution of transmission gear for tanks and the development during

the war of tank design, the work of R.E.M.E. in the field, rockets as weapons of war, and, following up rather than describing wartime work, the possibilities of nuclear energy. Last Friday two further papers dealing with wartime subjects were presented for discussion by the members. The first, by Dr. Wadlow, is concerned with naval mining, and the other, by Mr. Kirkby, with anti-submarine weapons. They fully sustain the standard set by the earlier lectures and papers, although their subjects have, perhaps, a rather less spectacular appeal. But, since both papers are on the long side and both are copiously illustrated, we have been forced by shortage of space to make an invidious choice. We hope that in printing an abstract elsewhere in this issue only of one of them we shall also direct attention to the high merits of both.

Figures have recently been published about the number of enemy submarines destroyed during the war. As many as 996 were sunk by the Allies. But how many of that number were casualties as a consequence of depth-charge attack and how many were hit and sunk by the "Hedgehog" projectiles described in Mr. Kirkby's paper we do not know. The former weapon was undoubtedly responsible for the majority of "kills." For the "Hedgehog" weapon did not come into use until a comparatively late stage of the war. Moreover, since the "Hedgehog" was far less likely than the depth charge to provide evidence in the form of wreckage to prove how well it had done its work it is improbable that it will ever be known with certainty for how many submarines it was accountable. All that can be said is that mathematically the "Hedgehog" has a greater chance of success in any individual attack upon a submarine than the depth charge. But the matter is very different with mines. A speaker in the discussion was able to state categorically that 1600 enemy vessels had been sunk or damaged by mines and to calculate how many mines had to be laid per casualty inflicted. No doubt, too, in the archives of the Navy the calculation has been carried further to distinguish between mines laid by surface ship, by submarine and by air, and between contact and other forms of mine, magnetic, acoustic, &c. Papers dealing with the technical engineering side of such subjects by those intimately concerned in the work described are bound to be interesting and instructive. Yet, curiously enough, in distinction to conditions ruling when earlier lectures and papers on wartime subjects were being presented before the Institution, the attendance was not even sufficient completely to fill the meeting hall and fell far short of those crowded conditions demanding that overflow capacity elsewhere in the building should be brought into use, to which members have become accustomed when the subject before the meeting proves particularly attractve. So considerable a fall in attendance at a meeting with a wartime subject gives rise to certain speculations. Undoubtedly, after the 1914–18 war, interest in what was done in the engineering works of this country in the manufacture of munitions of war evaporated with some rapidity. Is history about to repeat itself?

None of those very many engineering firms which during the war turned from peace-time routine to the making of warlike stores will ever fail to take pride in their achievements. The number of books and pamphlets issued since the war describing the wartime work of individual firms bears witness to the intensity of that pride. Yet, after all, hostilities are now far behind us. Engineers have become engaged in a different kind of battle, an economic one, in which eventual success depends, just as victory did in the war years, upon raising output. 'But the products of peace are far more varied than those of war. Moreover, in the making of them those mass and group production methods economically applicable in meeting enormous wartime contracts are often no longer suitable. Thus, the immediate present interest in developing and increasing peace-time production and in solving the many technical and productive problems involved may naturally be expected soon to overlay the intense but essentially evanescent interest that was aroused by attempts to meet wartime productive needs. Moreover, basically, engineers are men of peace rather than of war. Theirs is a constructive not a destructive profession. When the need is great, as it is in war, they are ready to develop and improve upon destructive weapons, taking pride rather in the skill with which they are made than in the work they are designed to perform. But their true bent is that to which the bulk of them have now returned—the building up of the material wealth of civilisation to higher and higher levels. Only those wartime developments which clearly have peaceful applications, such as the use of nuclear energy and the gas turbine, can be expected, therefore, permanently to hold their interest in the years following upon a war. Yet the pride in wartime achievements certainly remains. It would, therefore, be deplorable if the technical achievements of engineers during the war were not placed on record, and we hope that reduced attendances at meetings, if they should occur, will deter neither those best qualified to describe the wartime work of engineers from writing papers, nor Institutions from publishing them when written. We hope, too, that a sufficient number of well-qualified engineers will continue to retain an interest in the technical development of weapons of war. For never again ought this country to find itself as it did in 1939 not only short of weapons with which to fight, but, as with tanks in 1940, with existing equipment pitiably inadequate to meet that of the enemy.

Obituary

CHARLES DAVIS TAITE

It is with regret that we record the death of Mr. C. D. Taite, M.I.E.E., on Sunday, February 1st, at his home in Bowden, Cheshire. A prominent figure in electricity supply circles, he had retired in 1946 after devoting more than fifty years to the development of this industry.

Charles Davis Taite was born on December 30, 1872, at Wootton Bassett, Wilts, and was educated at Norwich Grammar School and Faraday House. After serving an apprenticeship with Ronald A. Scott, Acton, Mr. Taite joined the staff of Ferranti, Ltd., in 1893. Two years later he was appointed electrical engineer to Southport Corporation, and from 1901 to 1906 he filled a similar position with Salford Corporation.

In 1907, with his appointment as chief engineer and manager of the Lancashire Electric Power Company, there began an association (interrupted by the Great War, when Mr. Taite served in the 8th Lancashire Fusiliers) which ended only with his retirement in 1946, when he held the position of managing director. Statistics do not always fairly reflect achievement, but some idea of the company's growth under Mr. Taite's management is expressed in the fact that in 1907 under 5½ million units of electricity were sold, whereas in 1946 the annual output was more than 716 million units. These figures suggest the extent to which the undertaking was built up into a service of much more than local importance, supplying, to-day, an area of some 1070 square miles in Lancashire south of the Ribble. Special Orders were secured for the many areas now served by the company, which was empowered to give supplies in Chorley in 1914, Adlington and Golborne in 1924, Leyland, Walton-le-Dale, Blackburn, Burnley and Clitheroe Rural Districts in 1925, and several others between 1925 and 1931. During the same period Electric Lighting Orders were transferred from two local authorities to the company and agreements were negotiated to give bulk supplies to a number of other local authorities. An important aspect of this work was not only that urban districts were served, but that electricity was brought to rural consumers over a wide area that might otherwise have been left without a supply.

Mr. Taite's service to the L.E.P. Company was, however, but a part of a larger contribution to the electricity supply industry. He was Chairman of the National Consultative Committee of the Central Electricity Board, Past Chairman of the Council of the British Electrical Development Association, and Past President of the Incorporated Association of Electric Power Companies. In his active career Mr. Taite held many offices concerned with matters such as, for example, the regulation of salaries and conditions of employment in supply undertakings. His membership of the Lancashire Industrial Development Council was but one of the many local interests through which he widened the purely professional aspect of his service to the community.

BERTRAM HORN

It is with deep regret that we have to record the death, suddenly, at his home, "Sideways," Manor Road, Barton, near Luton, on Saturday, January 31st, at the age of sixty-six, of Mr. Bertram Horn, who for over thirty-seven years represented Mirrlees, Bickerton and Day, Ltd., and the Mirrlees Watson Company, Ltd., in the South of England and the Midlands.

He was the son of the late Mr. George Horn, a miller at Kempston, and received his education at Bedford Modern School and technical training at Ipswich Technical College. In 1899 he became a premium apprentice with the firm of E. R. and F. Turner, Ltd., millers' engineers, of Ipswich, and, on completing his practical training, he stayed with the firm a short time as a draughtsman. In 1905 he was appointed chief draughtsman with W. Burton and Co., of Sudbury, Suffolk, and from 1906 to 1908 he was manager of the company. In that year he came to Croydon to act as sales engineer and representative to W. R. Dell and Co., a position he continued to hold until 1911, when he joined the sales staff of Mirrlees, Bickerton and Day, Ltd. He was associated with the installation of many oil engine driven pumping stations, power and

industrial plants in the South of England, the Eastern Counties and the Midlands. For many years he lived in Bedford, where he was a well-known figure. Eleven years ago he moved to Barton, where he took a keen interest in social affairs.

In 1946, when the firm of Mirrlees, Bickerton and Day, Ltd., was merged with Associated British Oil Engines, Ltd., Mr. Horn elected to remain with the parent company, the Mirrlees Watson Company, Ltd. He was an associate member of the Institution of Mechanical Engineers. From the outset he was a keen engineer, and although he did not attain to the greater heights in his chosen profession, he nevertheless gained an honoured place in the estimation of all with whom he came in contact.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

MAGNETIC AMPLIFIERS

SIR,—I feel that British engineers are too prone to ascribe inventions to our late enemies, and there seems no very good reason why Mr. Parr should give the Germans the credit for the magnetic amplifier, or more properly. transductor, on page 86 of your issue of January 23rd. This state of mind extends to the popular Press and makes it hard for the public to realise we won the war because of British engineering skill, and not in spite of it.

The present development of the transductor appears to be due to work in America and Sweden. In the *Electric Journal* for 1937 there are references to its use as a voltage regulator, and the whole of *A.S.E.A. Journal*, 1939, No. 5 and 6, is given over to an article by Lamm on its more involved aspects, such as positive feed back, &c. Even though the Germans applied this knowledge in the V 2, there seems no reason for suggesting that they were responsible for its development.

R. B. ROWSON

Wrexham, January 24th.

RAZOR BLADE LIFE

SIR,—Referring to the letter regarding the above in your issue of January 16, 1948, now the matter has been raised I would like to add that three to four months is common to me as the period in which I use the same Gillette type blade.

I have a sharpening machine made in U.S.A. but purchased in Manchester ten years ago at a cost of 12s. 6d.

This could easily be copied and produced in this country, and if any firm interested would contact me I would be pleased to show the machine to them.

C. E. HUGHES

Monton Green, Nr. Eccles,
Manchester, January 27th.

SIR,—I read "Tonsor's" letter in your issue of January 16th on the working life of a safety razor blade with both interest and amusement.

The writer seldom thinks of buying new blades, and on several occasions when an old blade has been discarded after anything up to about ten months' use (one gets tired of a thing), there has been a stubborn feeling that the new blade was not so keen as the old.

In my case the sharpening process, which was passed on by a friend, consists of pressing the blade on to the inner surface of a large plain glass tumbler with the index finger, and rubbing up and down in a direction parallel to the cutting edges, reversing the blade a few times in the process.

I should mention that the blades I use are of a fairly stiff variety.

D. W. KINNAIRD

Rugby, 27th January.

LOCATING PARTIAL BREAKS IN MULTI-CORE JUMPER CABLES

SIR,—Referring to the above article which appeared in your November 28th issue, I should like to point out that similar results can be obtained with the aid of an ordinary megger.

The company with which the writer is employed uses a number of semi-flexible multicore submarine cables for communication purposes between the shore and outlying loading berths. These semi-flexible cables are terminated by submarine flexible cables connected to floating buoys when not in use, and to a portable telephone on the tanker when required for service.

These cables frequently develop intermittent or partial breaks, especially near the ends. By operating continuously the megger and agitating the cable uniformly, beginning from the end and along its length, it is possible to detect any intermittent or partial break when the needle on the megger shows any marked deflection during this agitation. This method has proved successful on several occasions and has allowed us to detect and rectify partial or intermittent breaks inside the cable with no visible outside signs.

Z. FRIEDBERG, M.I.E.E.

Iraq Petroleum Company, Ltd.,
Haifa, Palestine,
January 31st.

THE STATUTE OF LABOURERS

SIR,—As we approach the six hundredth anniversary of the direction of labour it is instructive to hark back to earlier times. I quote from Green's "Short History of the English People," page 248, describing the devastated state of the country following the Black Death of 1348, when half the population of 3 to 4 millions perished.

"While the landowners of the country and the wealthier craftsmen of the town were threatened with ruin by what seemed to their age the extravagant demands of the new labour class, the country itself was torn with riot and disorder. The outbreak of lawless self-indulgence which followed everywhere in the wake of the plague told especially upon the 'landless men,' wandering in search of work, and for the first time masters of the labour market; and the wandering labourer or artizan turned easily into the 'sturdy beggar,' or the bandit of the woods. (Spivs and gunmen ?). A summary redress for these evils was at once provided by the Crown in a royal ordinance which was subsequently embodied in the Statute of Labourers. 'Every man or woman,' runs this famous provision, 'of whatever condition, free or bond, able in body and within the age of three score years . . . and not having of his own whereof he may live, nor land of his own about the tillage of which he may occupy himself, and not serving any other, shall be bound to serve the employer who shall require him to do so, and shall take only the wages which were accustomed to be taken in the neighbourhood where he is bound to serve' two years before the plague began. The labourer was forbidden to quit the parish where he lived in search of better-paid employment; if he disobeyed he became a 'fugitive,' and subject to imprisonment . . . but so ineffectual were the original penalties that the runaway labourer was at last ordered to be branded with a hot iron on the forehead. . . ."

All this naturally led, later on, to the preachings of John Ball and to the Peasant Revolt of 1381.

G. TILGHMAN RICHARDS,
M.I.Mech.E., F.R.Ae.S.

Hove, Sussex, February 8th.

Education Officer for Institution of Production Engineers

THE Council of the Institution of Production Engineers announces that an Education Officer has been appointed by the Institution and took up his duties on February 1, 1948. This appointment has been made in view of the ever-increasing interest being taken by technical colleges and industry in production engineering. The newly appointed officer is Mr. T. B. Worth, M.I.P.E., A.M.I.Mech.E., A.M.I.E.E., lately the head of the Production Engineering and Trades Course Section of the Birmingham Central Technical College. In his new office, Mr. Worth will maintain a close functional relationship with the Educational Committee of the Institution, which is responsible to the Council for the formulation of the Institution's policy in the field of technical education. He will establish liaison with Government departments, local authorities, educational institutions, professional bodies and industry. This liaison will enable the Institution to keep fully informed on current and future needs, as well as existing facilities, in the field of technical education, with particular reference to production engineering. In co-operating with technical colleges and examining bodies in the development of subjects specifically related to production engineering, Mr. Worth will have in view the development of Higher National Certificate Courses on the subject. The Council of the Institution of Production Engineers in making this appointment, hopes that it will not only serve to advance the status of the profession, to the benefit of British industry, but will also be of considerable assistance to the younger generation of production engineers.

Electricity Act, 1947

IN view of the announcement that April 1, 1948, will be the vesting date for the purposes of the Electricity Act, 1948, the Electricity Commissioners have been examining the factors which should govern applications made to them for the sanction of proposals involving capital expenditure. These considerations are set out in circular letters, dated February 6th, from the Commissioners to public authority and company undertakers respectively. Undertakers are asked to bear in mind the margin of time required for a sanction to be issued, since any sanction to borrow for electricity purposes not exercised at vesting date would thereupon become inoperative. It is desirable that essential electrical development required for the efficient working of existing undertakings should be considered in relation to the larger areas for which the Electricity Boards will become responsible after vesting date. The Commissioners therefore ask that any proposal involving capital expenditure in excess of £10,000 should be referred to the appropriate Electricity Board for its consideration before application is made to the Commissioners. Applications already submitted will be dealt with on a similar basis and the Commissioners state that they themselves will consult the appropriate Board over any projects involving more than £10,000 expenditure. Before placing any substantial orders undertakers are asked to consult the Board concerned, so that any plans for ultimate standardisation throughout the Board's area will not be prejudiced. The Commissioners wish to make it clear that the revised procedure detailed in their circular letters is not intended to apply to applications for consent or sanction to capital expenditure on generating stations and the Grid system; works required in connection with the national general plant programme should be expedited as much as possible.

Naval Mining and Anti-Submarine Weapons

INSTITUTION OF MECHANICAL ENGINEERS

AT a meeting of the Institution of Mechanical Engineers, in London last Friday, February 6, 1948, papers on "Mechanical Engineering Aspects of Naval Mining," by E. C. Wadlow, B.Sc., Ph.D., M.I.Mech.E., and "Some Mechanical Features in Anti-Submarine Weapons," by J. M. Kirkby, M.A., A.M.I.Mech.E., were presented. An abstract of the latter is printed elsewhere in this issue. The following is abstracted from the discussion :—

Discussion

Mr. O. Thornycroft said that the time saved by being able to use small-scale models to help in design was remarkable. In the course of developing under-water projectiles there was ample opportunity for comparing quantitatively the results of scale model trials with the final full-scale results, and the agreement was generally good. For example, the sinking speed of a stable projectile (i.e., one that did not turn sideways, like Mr. Kirkby's depth charge), calculated from drag measurements in the compressed air tunnel at the National Physical Laboratory (which was a tunnel in which the air pressure could be raised and very high Reynolds numbers obtained), agreed within 5 per cent with the results actually obtained in sea trials. The great advantage in the use of the compressed air tunnel in parallel with other model results was amply demonstrated during the war, due particularly, of course, to the fact that it was possible to reproduce the Reynolds number which would eventually occur in the prototype in the water in a tunnel where accurate drag and moment measurements could be made.

Mine with Floating Antenna

Mr. Stuart Miall described the development of a mine with floating antenna, which became his responsibility. In June, 1940, when he joined the department, the war was going rather well from the German point of view; there was a very definite threat of invasion, and a mine was required which would be effective against shallow-draught vessels at all states of the tide. There had already been conceived an antenna mine in which the upper antenna was buoyant, but this floating antenna was at that stage rather more of a beautiful dream than a practical reality, for the reason that any ordinary stranded wire, particularly if it had been rolled on a drum, had acquired a permanent set; and when it floated freely in water (supported, of course, by little floats) it coiled up into a rather tight tangle, and 60ft to 70ft of it occupied almost no space at all. It afforded, therefore, very small protection against enemy craft, and it was very conspicuous from the deck of a ship. It occurred to him that a wire with some self-straightening properties would have to be developed before the floating antenna could be used, and he thought of a material known in the household furnishing trade as expanding curtain rod. He purchased some of this material from Woolworth's in Portsmouth just before Woolworth's was blitzed, and had some little wooden floats made and went to a quiet creek to try it out. It worked extremely well.

They found a firm in the Midlands who were prepared to make this close-coiled helix, using bronze wire—it was necessary to have bronze wire for this purpose—and while they were making some sample lengths he schemed out some arrangements for stowing and releasing. Then there began a big argument with the Naval people. He realised that the force available for uncoiling the floating antenna, if it were to be simply the buoyancy of the floats, would not amount to more than a couple of pounds, which was a very small force to play with, and he wanted to have the antenna of one mine tied to the following mine, so that as a mine was tipped off the back of a minelayer its antenna would be automatically streamed before the mine fell into the sea. The Naval people, however, said that the antenna might foul the propellers of the minelayer, and they insisted on the floating antenna laying itself and streaming itself quite automatically. He devised a method for doing this, and trials were planned, but then the electrical department reported that the single-strand helical wire was not going to be of any use because its electrical resistance was much too high. He had fondly imagined that the electric current would flow from coil to coil along the whole antenna, traversing a distance of about 60ft in all; but instead of that it flowed round the helix, making use simply of the helical path, and, of course, the resistance was very high. It was therefore necessary to contact the wire firm again to ask whether they could make a wire in which there were five or six strands in parallel. That was rather a big proposition from their point of view; they had never tried anything like it before. However, in a short time they were supplying 70ft-lengths of a five-strand wire. That wire was very much stiffer than single-strand wire, so that it was necessary for him to redesign the stowage and release mechanism. The original container for the single-strand wire was only about 1ft in diameter, but it was necessary to go at once to something about 3ft in diameter because of the greater stiffness of the five-strand wire.

The invasion threat, of course, came to nothing. The mines were ready for the expected invasion in the spring of 1941, which never came. They were afterwards used as an anti-submarine measure somewhere in the north of Scotland. He would be glad if Dr. Wadlow could tell him what happened about their use. Personally, he left the department in 1941 and never heard any more about it, but he would be very pleased to know that the mines had sunk some enemy submarines.

Depth Charge Thrower Arrestor Gear

Mr. H. E. Sharp, speaking of the depth charge thrower, said that an interesting shock effect was experienced during the development of the arrestor gear. The two arrestor cylinders were connected by a pipe to ensure equal pressures in the two cylinders. This pipe was made of steel, $\frac{1}{4}$in bore, and $\frac{9}{16}$in outside diameter, and it was capable of withstanding an initial pressure of at least 30,000 lb per square inch. The pressure built up in the arrestor cylinders during the arresting stroke was only 5500 lb per square inch, and yet on two or three occasions when firing a proof round an equalising pipe was split longitudinally for a length of 2in or 3in. The quality of the pipe material was naturally suspected, but was found to be exceedingly good, with regard both to ultimate strength and ductility. Measurements were then made of the pressure reached by the liquid in the pipe, and readings varying from 10,000 lb to 28,000 lb per square inch were obtained. The equalising pipes used in the trials withstood those pressures and showed no signs of excessive stress, but the trials showed that pressures far in excess of the cylinder pressure could be produced in the equalising pipe. The explanation was thought to be that at the instant that the piston entered the arresting cylinder a pressure of 5500 lb per square inch was built up in less than 1 millisecond. Pressure waves were produced almost simultaneously in the two arrestor cylinders, and occasionally met in the equalising pipe. When this occurred, the wave energy was absorbed mainly in stretching the pipe at the point where the waves met, and, with so small a volume of metal to absorb the energy, excessive pressures were produced. Acting on that hypothesis, a restriction plug of $\frac{1}{8}$in bore was fitted on each end of the equalising pipe to reduce the amount of wave energy entering the pipe, and this proved to be a complete cure.

Mr. A. Ogden said that the variety of operational needs and uses of mines had of necessity to be matched by an equal flexibility in supply, since mines might be, and indeed were, required in large numbers, and in the shortest possible time. This might well entail a bewildering variety of types, which would make unacceptable demands on manpower and storage space. To get over this difficulty, the British practice had been to regard the mine shell as merely a container, and to rely on ingenious combinations of a relatively small number of different components to achieve a variety of firing systems. This meant that in general the manufacture of mine shells and the manufacture of components were dissociated one from the other, and the work of assembly and storage was undertaken at Royal Naval mine depots, manned by civilian staff.

Mr. A. Lightbody, referring to a depth-charge described in Mr. Kirkby's paper, said that in the original form, this store was a plain cylinder with a blunt nose, and it was found that its air ballistics were not very satisfactory when dropped from a reasonably high altitude. It was in trying to increase the terminal velocity that difficulty was encountered. In the early days a radiused nose was fitted to this depth charge, the radius being of the order of 0·07 times the diameter. In the earliest trials which were carried out it was found that the dispersion of the store was rather large and, after a certain amount of investigation, it was discovered that the nose radius was extremely critical. In fact, if the radius was much less than 0·1 of the diameter, the drag coefficient of the store was high, of the order of 0·8, whereas if the nose radius was of the order of 0·1 of the diameter or more, the drag coefficient was low and was of the order of 0·22. The interesting fact which came out in those ballistic trials was that it was extremely important not to err on the low side, because if one did, the drag coefficient was liable to vary considerably during the flight of the bomb, and inconsistent ballistics could result.

Mr. A. Stuart Watts remarked that a few further remarks on wire-mooring

ropes might be of interest. As far as mooring ropes were concerned, certain conditions had to be met: (i) there must be a minimum of stretch and elongation; (ii) the wire had to be reasonably flexible; (iii) a fairly large diameter wire was needed, with protection to delay corrosion, and (iv) there should be maximum strength with minimum size. The most desirable construction of rope to meet those demands was 7 by 7, with six strands each of seven wires closed over a coil of seven wires. The wires were galvanised and drawn to a tensile strength of about 110 tons per square inch. The $1\frac{5}{16}$in circumference type was required to give a breaking load of about 7·75 tons per square inch and the 1in circumference a breaking load of 4·5 tons per square inch.

During the recent war, the task of galvanising such a vast quantity of wire of such small diameter became a bottleneck. The rope industry had to satisfy huge demands for aircraft, rockets, parachutes, and the numerous other devices in use. Fortunately, the manufacturing plant was such that the demands could be met, but that was not the case with galvanising. The problem was solved by the use of drawn galvanised wire. In this process the wire was galvanised during the drawing stages at a larger size than the finished gauge required. For example, a wire to finish at 0·040in diameter could be galvanised when its diameter was 0·128in and then drawn down to the required final size. This enormously increased the output of the available galvanising plant and also enabled the heavier galvanising plant, which had previously been immobilised, to be brought into operation. Wire galvanised by a hot process and then drawn down to size would not have such a thick coating of zinc as wire hot galvanised at its finished diameter, but the method enabled the huge Service demands to be met.

Mines and the Navy

Captain R. Oliver-Bellasis, R.N., believed that there was one error in the author's historical review, because he thought that magnetic mines were in fact used in the first world war off the Belgian coast, in what was called the M sinker, which was a simple form of magnetic dip needle. It was interesting to note that that was the type adopted by the Germans for their own magnetic mine. The Germans made a beautiful job of their magnetic mine. He was not saying that we did not do the same of ours, but the Germans had a lovely aluminium shell and the inside was a first-class instrument job. It must have represented a great effort on the part of their light precision engineering industry. Our own mines were made with much greater regard for economy in our industrial resources. He remembered seeing the first German mine to be opened up and wondering why our designers had not done the same sort of thing, but he realised afterwards that they would have been sacked if they had even suggested it. The clocks were interesting, and he hoped that Captain Cowie, who was in charge of operational mining during the war, would say something about them. They had to be set to very accurate timing. That worked both ways and it was with mixed feelings at the beginning of the war that a clock was recovered. He had been in Portsmouth when a clock was recovered set to eight days' time, and it was interesting to speculate what that meant. Fortunately, nothing happened, but it was one of the fairly accurate forecasts of the date of invasion.

Captain J. Cowie, R.N., said that it had been his privilege to be associated for ten years, 1935–45, with the employment of mining material and equipment, for a few years before the war in the conduct of sea trials, and throughout the war in the planning of our minelaying campaign. That campaign involved the laying of some 263,000 mines, of which some 80,000 were laid in enemy waters, and resulted in the sinking of or severe damage to 1600 enemy ships. That meant a return rate of fifty mines to a casualty, which in terms of pounds, shillings and pence was about the same as two torpedoes.

It was with some diffidence that before his present audience he drew a distinction between the scientist and the engineer, but he thought that it was fair to say that the contribution made by basic research to results of the kind in question was widely appreciated and applauded, particularly by the public, and it was equally fair to say that the contribution of the engineer was not so widely known or applauded. That was particularly so in Service circles. It was sometimes very difficult to convince distinguished officers, who clamoured for something to be produced quickly, that the idea of the scientist could not be translated in terms of weapons and material until it had been engineered, and that that inevitably took time. It was equally difficult—this had already been mentioned—to convince the average user of warlike equipment that what appeared to him to be the merest touch of modification might cause the utmost dislocation. He himself, as Dr. Wadlow would no doubt confirm, learned that lesson many years ago.

Commander P. Bethell, R.N., retired, remarked that in the field of mines, the hoary and woolly old dictum that the mine was the weapon of the weaker naval power had in the past led to a frightful state of stagnation, which he could best describe by recalling that in the first world war this country did not have an efficient mine until we made an exact copy of the German one, and that was not done until 1917. In the recent war, however, we had—and he said this as one who had always been interested in what the Germans were doing—made much better progress, and the race was pretty even; sometimes we were a little ahead, and sometimes the Germans were, but neither side was ever very much in advance of the other. The German system of mine development and depth charge development was similar to our own; i.e., it was done in naval establishments directly responsible to the German Admiralty. However, in 1942, Goering brought about one of his cataclysmic changes by insisting that all mines and depth charges, and all other weapons, in fact, which were used by aircraft, must be the sole responsibility of the German Air Ministry. That, he had been told, led to a very considerable stagnation in progress, but to a phenomenal increase in production, because the German Air Ministry had very much better manufacturing priorities than did the German navy.

There was one minor point which he would like to make. The paper by Mr. Kirkby referred to the deck thrust given by these large mortars or depth charge throwers, which was especially unpleasant in the case of lightly-built coastal craft and small vessels generally. The Germans had a clever though fairly obvious way of getting round that; with light craft, instead of using a mortar they had a rocket-propelled depth charge, which, of course, had no deck thrust at all. By this means a depth charge very similar to that used by us was propelled by rocket for a range of about 650 yards.

The Chairman thanked the authors for their papers and the meeting closed.

Starting Conditions for A.C. Motors

With a view to securing uniformity, certain recommendations, for the starting conditions of a.c. motors (up to 650V) on public supply mains, have been made by a joint committee representing the several electricity supply associations and the British Electrical and Allied Manufacturers Association, under the chairmanship of Mr. D. Maxwell Buist. These recommendations, which have the approval of the Ministry of Supply and the Electricity Commission, are contained in a booklet obtainable (price 1s.) from the B.E.A.M.A., 36–38, Kingsway, London, W.C.2.

In an introduction to the committee's recommendations, it is pointed out that the existing regulations in different supply areas make it difficult to choose the kind of motor and the method of starting that will be permissible in specific circumstances. This diversity of practice can exercise a restrictive influence on the use of electric motors generally and on squirrel-cage motors in particular. It is observed, for instance, that the horsepower limitation which is sometimes stipulated as a factor in the starting condition of squirrel-cage motors, is not necessarily a criterion of the disturbance produced on the supply system at starting.

The recommendations under review are based on starting current which, it is thought, is a more logical limiting factor than the kind of motor, its horsepower or the method of starting. On this basis, provided that the agreed limitation of starting current is not exceeded, users, manufacturers and contractors will be free to choose the most suitable motor and method of starting for any given drive. These recommendations allow the supply authorities to select the most appropriate starting current limit at the point on the system where a supply is to be taken for motors.

It is suggested that the user when making the usual application for industrial load should provide technical particulars of the motors and starters, including the number of starts per day. According to the conditions at the point of supply, the supply authority will then specify the permissible limit of starting current for all motors not exceeding 650V. This limit will fall into one of five categories—above 200A, 200A, 100A, 50A, and below 50A per line. This last class is not recommended except in special circumstances, such as in rural areas, where a lower starting current limit may be desirable to prevent undue disturbance to consumers' supplies, and in such cases the permissible starting current should not be less than 25A.

Where a high-voltage supply is given direct to a consumer it is suggested that the setting of the supply authorities' protective apparatus should determine the stipulated permissible starting current.

The recommendations conclude with some explanatory notes on the initial starting current of squirrel-cage motors with different methods of starting. An example quoted is the case of a class "C" consumer with a supply of 415V, 3-phase, 50 cycles, the permissible starting current being limited under these recommendations to 100A per line. Such a consumer would be permitted to use direct-on starting for a 10 h.p. squirrel-cage motor, with a stand-still current of 95A. Similarly, star-delta starting could be used for a 30 h.p. squirrel-cage motor with a standstill current of 258A, and auto-transformer starting, with a 75 per cent tapping, for a 20 h.p. squirrel-cage motor with a standstill current of 160A.

It is pointed out that, in some installations, the type of motor and method of starting may

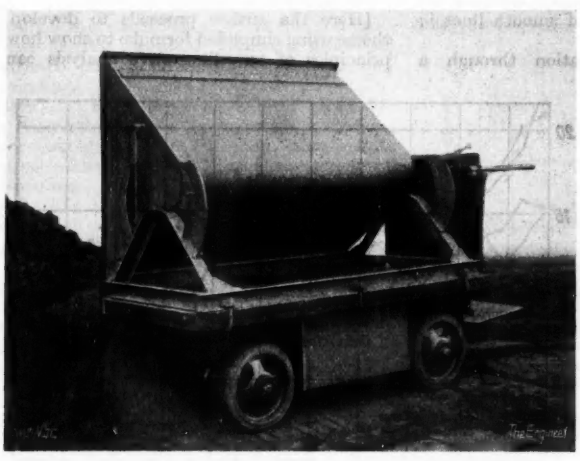
have to be chosen by mechanical considerations requiring, perhaps, a lower starting current than that permitted by the committee's recommendations. Welcome encouragement is, however, given to wider use of the squirrel-cage machine, which has the merit of being the simplest and most robust of a.c. motors.

Battery-Driven Dump Truck

We have received some interesting details of a battery-driven dump truck suitable for handling loose material in loads up to 15 cwt. This equipment, which is marketed by Crompton Parkinson, Ltd., Astor House, Aldwych, London, W.C.2, consists of a side tipping hopper mounted on the well-known 1-ton flat deck "Electricar" industrial truck.

The general arrangement of the hopper can be seen from the accompanying illustration. Four welded channel section members form the base, which is secured to the flat deck of the truck by six J bolts, so that it is a simple matter to remove the hopper assembly, whereupon the equipment reverts to the form of the standard 1-ton truck. The method of supporting the side tipping hopper on its base-plate without the use of an axle is simple in its ingenuity. As the hopper is tipped to one side or the other by hand so the flat welded projections at the front and rear ends rock on the curved portions of the angle iron supports. At the same time, the ends of these projections are constrained to slide along one or other of the curved guide pieces which are welded to the front and rear supports. One of the guide pieces at the front and another at the rear carries a bracket drilled to receive a locking pin, so that the hopper can be locked in the loaded position. A reinforcing strip is welded below and parallel to the top edge of each side of the hopper to withstand any impact produced when the hopper reaches the fully tipped position. The hopper is manufactured for Crompton Parkinson, Ltd., by St. George's Engineers, Ltd., Salford, Lancs.

The "Electricar" truck itself embodies some recent improvements on an already well-established design, and no more than a brief description of this part of the equipment is required. For the sake of completeness the



BATTERY TRUCK WITH SIDE TIPPING HOPPER

leading dimensions and data are tabulated herewith.

Principal Dimensions

	ft	in
Platform length	6	0
Platform width	3	0
Wheelbase	3	11
Overall length	8	1
Overall width	3	0
Turning circle (radius to the outer corner of truck)	9	3

It should be observed that the turning circle is sufficient to allow the vehicle to be turned from a 6ft gangway into another of the same width, at right angles to the first. Steering is by vertical tiller with ball and socket connections controlling two wheels. The wheels are of malleable iron fitted with lubricated ball and roller bearings. Although solid tyres, 16in by 3in are standard, pneumatic tyres can be fitted at an extra cost. Semi-elliptic springs are fitted all round.

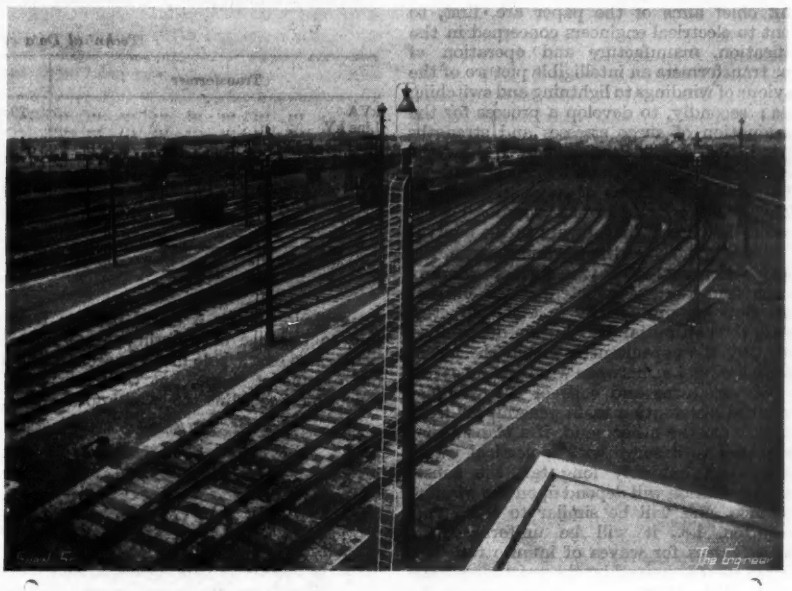
Transmission from the totally enclosed series wound traction motor is carried by a tubular propeller shaft with Hardy Spicer universal joints. The worm driven axle is enclosed with a bevel differential gear. Lubrication is by the "Tecalemit" system throughout.

Foolproof operation is claimed for the electric drive and its control gear. The brake is spring-loaded so as to be "on" unless the pedal is positively depressed by the driver's foot. Releasing the brake pedal causes the current to be cut off automatically at the same time as the brake is applied. The Ferodo lined external contracting brake shoes operate on a drum mounted on an extension of the motor armature shaft. Another safeguard against careless handling is provided by an interlock which ensures that the controller handle must be returned to neutral after the foot brake has been applied before the truck can be restarted. The controller provides three speeds forward and three reverse, and without the safeguard just described any attempt to start the truck in the full speed running position would impose severe stresses on the motor and transmission.

The performance attributed to this truck by the makers is interesting. With its hopper fully loaded the truck is designed to climb a gradient of 1 in 7 and to cover 16 miles at 4·6 m.p.h., which is equivalent to 3·7 hours of continuous running on a single charge of the battery. Unloaded, the top speed is specified as 6·2 m.p.h., allowing the vehicle to cover 38 miles per charge, running continuously for six hours.

A truck working over a given distance with a full load and returning empty is capable of covering approximately 27 miles in a running time of about 4·85 hours.

To provide for continuous working, a spare battery can be used, the housing being arranged to allow the batteries to be interchanged quickly and easily.



TOTON DOWN SIDINGS

Modernisation of Toton Marshalling Yard

The traffic yard at Toton sidings, between Nottingham and Derby, is the keypoint in the London Midland Region of British Railways for the reception of coal traffic from the North Midland coalfields. In it some 2700 coal wagons are marshalled daily into trains for the south, east and west of England. The down side of this yard, comprising about half of the sidings, was completely modernised and mechanised by the late London Midland and Scottish Railway Company in 1939. It has now been announced by Sir Cyril Hurcomb, of the British Transport Commission, that the up side of the yard is to be modernised and mechanised in a similar manner, to enable some 500 to 600 additional coal wagons daily to be shunted and marshalled.

The yard to be modernised comprises ten arrival lines, which are of insufficient length to accommodate the long full train loads now being hauled by modern locomotives. In it at present shunting is effected by gravity and the movement of the wagons is controlled by means of hand brakes. Its departure and storage facilities for holding temporary rushes of traffic are inadequate, and these factors tend to slow down the working of the yard, particularly at peak periods.

The scheme of improvement now proposed will involve the provision of arrival lines of adequate length, together with special signalling equipment to expedite the movement of wagons over the hump, whence they run down to sorting sidings. Power-operated brakes will be installed to slow down the wagons as they run into the sidings. Power-operated points will facilitate and speed sorting and, from a new control tower, operators will be able to control the movement of wagons into the sidings. Increased storage siding accommodation will be provided together with improved lay-out of marshalling and departure facilities. For night working electric lighting is to be installed throughout the yard and instructions from the control tower will be transmitted by loud speakers.

At the time of their modernisation in 1939 the Toton down sidings, a view of which we reproduce, were said to be dealing with the greatest number of wagons over one hump in the world.

The Lightning Strength of Power Transformers*

By E. T. NORRIS, M.I.E.E.†

THE chief aims of the paper are, first, to present to electrical engineers concerned in the specification, manufacture and operation of power transformers an intelligible picture of the behaviour of windings to lightning and switching surges; secondly, to develop a process for the determination of surge stresses and strengths that is logical and is clear enough to show the inter-action of the chief factors concerned.

The orthodox analysis of surge-stress distribution within a transformer winding[1,2,3,4] is based on the theory that, owing to the equivalent high frequency of the incoming surge, the inductive elements of a transformer winding are not immediately affected, since current cannot flow instantaneously in the conductor. There is thus an initial distribution determined entirely by the capacitances within the transformer winding, i.e., between winding and earth, and between turns and coils of the winding. This initial distribution is, in general, far from uniform. On the other hand, if a transformer is subjected to a surge with a vertical wavefront and an infinitely long tail, the subsequent distribution will depend upon the winding inductance, and will be similar to the 50 c/s distribution, i.e., it will be uniform. The ultimate values for waves of infinite tail will, of course, be determined by the resistance of the winding. This distribution will not usually be much different from the inductance distribution, but, in any case, is not of importance since such long waves do not occur in practice.

TRAVELLING-WAVE ANALYSIS

It is possible to analyse the behaviour of a transformer winding under surges not in the form of standing waves but in the form of travelling waves. This method has been known mathematically for many years[6,7,8] and has been given some attention, particularly in Germany. The incident wave is represented as an infinite series of sinusoidal components, and the resulting differential equation is analysed to determine the conditions under which these waves can enter the winding.

An exposition of the principles of the travelling-wave method has been given by Rudenberg [7,9] for windings with uniformly distributed insulation, and for incoming surges with vertical wave fronts and infinite tails. These principles are summarised briefly here, and the method is then extended to include the consideration of varying wave shape, non-uniform insulation, and different types of coil and winding. In the course of this development, numerous curves are given showing its application to actual transformer windings of various types and sizes, and in many cases comparisons of calculated with measured values are included.

For ease of reference the transformers are labelled A to F. The principal characteristics, such as rating, type of winding and overall proportions are tabulated herewith.

In the orthodox theory of travelling waves on transmission lines, a surge passing from one line to another of differing surge impedance penetrates as a whole into the second line without change of shape, but with refraction and reflection according to well-known laws. A transformer winding according to the present theory is, however, able to propagate only those oscillations having a frequency below a critical value. Higher-frequency oscillations cannot penetrate deeply into the winding, but establish a standing exponential distribution exactly similar to the initial distribution of the standing-wave analysis. (A triple division has also been suggested.[9])

Thus, the higher-frequency components form a standing potential distribution, and the lower-frequency components a travelling wave. This splitting of the incoming surge into two parts is a distinctive feature of the travelling-wave theory, and is the main difference between the treatment of windings and of smooth lines in this respect.

A typical surge propagation through a wave and cause negative stresses at or near the neutral point. These stresses are not, in general, of practical importance and are neglected here.)

It has been pointed out that in this analysis a component of mutual inductance between turns and coils of the winding has been ignored. The resulting error is not easily determinable, but from the results obtained, the approximation would appear to be generally justifiable.

The travelling-wave component travels through the winding and is reflected at the neutral point in the usual manner, depending upon whether the neutral is earthed or insulated. The wave becomes distorted in its course through the winding, since the component frequencies have different velocities.

The practical application of the travelling-wave analysis is clearly demonstrated in Fig. 2, in which a series of cathode-ray oscillograms, each showing the voltage between individual coils of a large transformer with disc-coil winding, are assembled in sequence. The number of the coil from the line end of the winding is given above each oscillogram. The propagation of the travelling wave along the winding is clearly shown, together with the attenuation due to damping. The increase in amplitude at the earthed end of the winding is due to reflection, as explained later in the paper.

An analysis such as this is much simpler for the practical determination of inter-coil stresses than is the computation, involving a synthesis of harmonics, both in space and time, required by the standing-wave analysis. In addition, it is readily applicable both to non-uniform windings and to incoming surges of varying wave shape.

[Here the author proceeds to develop his theme using simplified formulæ to show how the principles of travelling-wave analysis can be applied in practice to transformers allowing for non-uniform windings, end reflections, and the effect of wave shape.]

Typical curves showing both calculated and measured values of inter-coil stress distribution are given in Fig. 3.

INITIAL DISTRIBUTION

Reverting now to the initial electrostatic distribution of the surge throughout the winding, plotted from cathode-ray oscillograms taken on transformer B, is shown in Fig. 1. The progress of the wave along the winding is clearly shown to be in accordance with theory. Each curve gives the voltage distribution along the winding at a stated time in microseconds from the initial application of the surge to the line terminal. (The complete travelling-wave theory includes small forerunner voltages, which precede the front of the

Technical Data on Transformers Tested

Transformer	A	B	C	D	E	F
kVA	20,000	60,000	40,000	3,000	500	100
Line kV	132	132	88	110	11	33
L_T, total length of conductor, ft	11,500	8,280	5,200	23,200	4,050	25,500
X, initial distribution space constant, ft	410	540	500	1,100	440	1,730
L_T/X	28	15·3	10·4	21	9·2	14·7
Type of h.v. coil*	d	d	d	d	b	b
Number of h.v. coils	122	62	64	154	12	20
Ratio max./min. conductor insulation	3·9	3·0	3·4	5·0	1·8	7

* d—Double disc winding
b—Bobbin winding

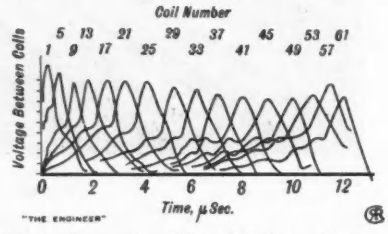


FIG. 2—*Propagation of Inter-Coil Stress Through a Transformer Winding*

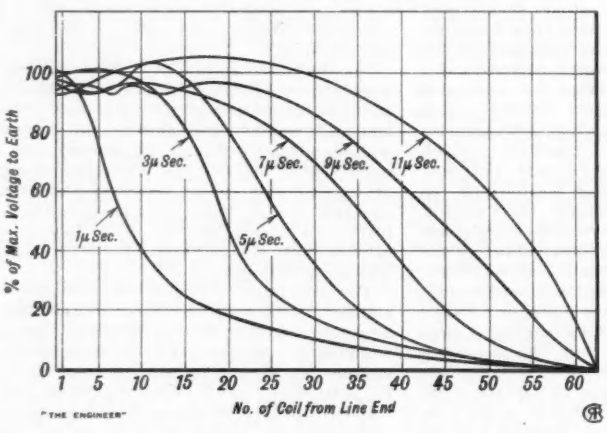
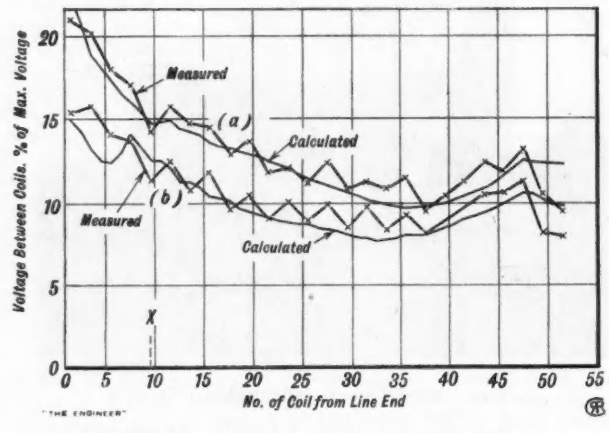


FIG. 1—*Surge Propagation Through a Transformer Winding*



Curve (*a*)—Stress distribution without electrostatic shields.
Curve (*b*)—Stress distribution with electrostatic shields

FIG. 3—*Inter-Coil Stress Distribution of Transformer.*

* Institution of Electrical Engineers, Transmission Section London. January 21st. Abstract.

† Ferranti, Ltd.

winding, which is the basis of both standing-wave and travelling-wave methods of analysis, it follows that the determination of this distribution is the first step in the calculation of surge stresses. The electrostatic characteristics are determined by the capacitances between turns and coils, and between the individual turns and coils and earth. For this purpose, the term earth includes the core, the low tension winding and framework, and also the tank, and for three phase transformers, the remaining phase windings. This electrostatic condition

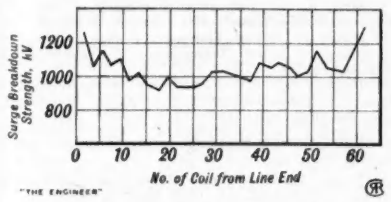


FIG. 4—*Surge Distribution of Transformer*

may be visualised by imagining that every turn of the winding is cut in one place so that no current can flow along the conductor. The determination of the electrostatic distribution is, therefore, purely a matter of calculation from a more or less complicated combination of capacitances in series and in parallel. These combinations are usually so complex that rigorous mathematical calculation is extremely laborious, if not impossible, and simplified formulæ are usually employed which, whilst not strictly correct, are sufficiently so for practical purposes. The formulæ also take account of fringing effects.

These circuit calculations can, if desired, be checked experimentally, though indirectly, by means of a calculating board[13] in which a network of impedances (usually plain resistors) is set up to represent the elemental capacitances of the transformer winding. The initial-distribution voltage corresponding to any point can then be measured by a potentiometer type detector. It is still, of course, necessary to calculate accurately the elemental capacitance values.

Surge Strength of Transformer Windings

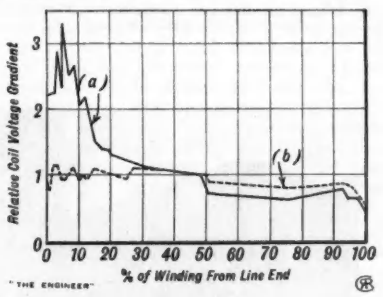
The foregoing analysis makes it possible to determine the distribution of surge voltages throughout the winding for any practical wave shape, and for any practical arrangement of windings and inter-coil and inter-turn insulation. Illustrations have been given of such calculations for a wide range of transformer characteristics. The main purpose of these calculations is to determine the strength or resistance of the windings to incoming surges. For this purpose, the surge voltage stresses at all points at which breakdown might occur, such as between turns and between coils, and from windings to earth, must be related to the strength of the insulation at those points. If this is done, then a curve can be plotted showing the amplitude of an incoming surge that would give rise to stresses equal to the breakdown values throughout the winding. An example is shown in Fig. 4 for transformer B, which gives the surge strengths corresponding to the surge-voltage distribution shown in Fig. 3(*a*). This curve shows that the minimum strength is about 920kV and would occur about one-third of the way down the winding from the line end.

Stress-Control Design.—Consideration of the surge-voltage distribution and the surge strength in this manner makes it clear that the ideal is not essentially uniform voltage distribution, but rather uniform voltage stresses in relation to the breakdown values. It does not matter whether the voltages between turns and coils are equal throughout the winding, so long as the insulation is in proportion and is appropriately increased in those places where the maximum voltages are relatively high. The preceding sections have described how this internal stress distribution can be calculated. An intensive mathematical and experimental study of these relations has been made during the last 15 years, and the curves given herein are typical of the results obtained. This work has shown that considerable increase in winding strength is possible with the inter-turn and inter-coil insulation correctly proportioned and distributed in accordance with the principles outlined above, and with, in some cases, the addition of simple capacitors or electrostatic shields. The basic principle is that the stresses between turns and coils are predetermined by the insulation distribution in such a manner that this same insulation provides ample margin of electric strength over the corresponding electric stress in all parts of the winding for any given type and severity of incoming surge. This balance is obtained by detailed calculations as outlined [in Sections 5 to 7 of the paper] for each individual winding arrangement. The use of the insulation that actually provides electric strength to control simultaneously the corresponding electric stress has given rise to the term "stress control" as a title for this method of design.[15] A typical illustration is shown in Fig. 5, which has been constructed from measurements made on 5-MVA, 3-phase, 33-kV transformers of standard and of stress control design. The improvement is in this case in the ratio of one to three.

Typical Applications

Since until recently there has been no practical method of calculating in detail the inter-coil and inter-turn surge-stress distribution, present-day practice is largely empirical. Early operating experience showed clearly the apparent need for reinforcement of the end-turn insulation, as breakdowns due to lightning surges frequently occurred there. The concentration of stress on the end turns of a uniformly insulated winding is obvious from consideration of the initial distribution of voltage. It is also apparent from the equations that increasing the insulation of turns and coils tends to defeat its own ends, as the accompanying increase in spacing reduces the capacitance C_n between coils and thereby increases the inter-coil voltage and possibly even the resulting stress, so that the surge strength then becomes worse instead of better. This condition in fact frequently occurs with present-day standard practice.

It is commonly specified that the insulation between 1 per cent of the turns at the line end of a power-transformer winding shall withstand full line voltage. The insulation is then to be graded downwards through the next 4 per cent

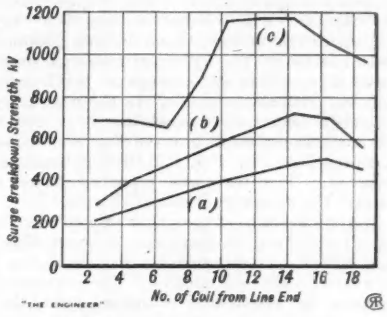


Curve (*a*)—Standard winding.
Curve (*b*)—"Stress-control" winding.

FIG. 5—*Typical Effect of "Stress-Control" Design on the Surge Distribution Throughout Transformer Winding.*

to a strength of one-fifth of line voltage for the remainder of the winding. It is fairly safe to say that such reinforcement is in general far from efficient. The reinforcement specified in B.S. 422 is smaller in degree but similar in distribution. It will be clear from the principles of surge-stress distribution described earlier in the paper that effective inter-turn and inter-coil insulation cannot be specified in this manner, but is individual to the particular winding proportions and must be treated as a component of the integral design. The frequently unsatisfactory behaviour of transformers with windings reinforced in the customary manner, and the realisation of the deleterious effect on the voltage distribution, led to misgivings about the value of reinforcement and even to suggestions of reversion to uniform insulation. Generalisations are, however, impossible as the illustrations in the preceding Sections show.

As a typical example of the effect of inter-turn and inter-coil insulation, Fig. 6(*a*) shows the calculated surge breakdown-strength of a 100-kVA, 33-kV, 3-phase transformer (transformer F) built with the inter-turn reinforcement described above. In the first alternative, all the reinforcement was removed and replaced



Curve (*a*)—Normal inter-turn insulation.
Curve (*b*)—Uniform inter-turn insulation.
Curve (*c*)—"Stress-control" inter-turn insulation.

FIG. 6—*Calculated Surge Breakdown Strength of Transformer for Various Values of Inter-Coil Insulation*

by uniform insulation throughout. Fig. 6(*b*) gives the result. Comparison shows that the reinforcement, far from increasing the surge strength, was actually harmful. This does not mean, of course, that some different kind of reinforcement would not have been better. In the third alternative, a measure of stress-control was introduced without changing the overall proportions of the winding. Fig. 6(*c*) shows the resulting improvement; the transformer became 3·2 times as strong. Moreover, the total of inter-turn and inter-coil insulation is less, and the transformer in consequence could be smaller and more efficient. The surge strength is now, however, appreciably greater than is required by the most recent American and British standard insulation levels, and the design could therefore be further improved to give even lower cost and better efficiency.

Full-Scale Surge Tests to Destruction

There are four stages in the complete process of establishing the surge strength of a power transformer.

(*a*) The calculation of stress distribution throughout the winding.

(*b*) The confirmation of these calculations by direct measurement at low surge voltages—most conveniently by the recurrent-surge cathode ray oscillograph.

These two stages are covered by Sections 5 and 6 of the paper.

(*c*) The calculation of the surge breakdown distribution by combination of the stress distribution and the corresponding dielectric strengths of the insulation (Section 9). Fig. 4 is a typical example. This calculation gives not only the estimated minimum breakdown value, but also its position in the winding.

(*d*) The confirmation of the calculated surge strength by actual tests to destruction. These are naturally full-scale tests on completed transformers. Since such transformers cannot be put into service, the tests are expensive and are therefore planned to cover as wide a range as possible at as little cost.

Since the general procedure is similar for all ratings, one typical example will suffice.

The tests were made on the h.v. winding of one phase of a 20-MVA, 3-phase transformer, of ratio 132/33-kV, with on-load tap-change gear for ± 10 per cent on the h.v. winding. The windings were arranged in double concentric formation with the l.v. winding in the middle. Fig. 7 shows the calculated surge breakdown-strength distribution in accordance with stage (*c*) above.

The American standard 1·5/40-microsec wave

was employed, both as a full wave and alternatively chopped by rod gap to give a steeply backed tail. The British standard wave is 1·0/50 microsec with tolerances on both wavefront and tail sufficient to embrace the American figures.

After the preliminary calibration tests, two full-wave surges of 726kV were applied as shown in Fig. 8. These surges also acted as reference tests to be repeated after subsequent higher-voltage surges. Comparison with the original wave shapes is one useful means of detecting incipient failure. Two chopped surges of 836kV and 805kV were then applied. Fig. 8(*b*) shows one of these records with chopping at 15 microsec. The full-wave reference surges were then repeated and gave oscillograms identical with the originals. In the next stage, the surge amplitude was increased to 890kV. The cathode-ray oscillogram in Fig. 8(*c*) shows, in comparison with Fig. 8(*b*), that damage had occurred. The test was repeated twice to confirm the failure.

The whole series of tests thus proved that the surge breakdown strength was between 836kV and 890kV. Reference to Fig. 7 shows a calculated value of 900kV. This agreement between the actual and estimated strength is closer than is necessary to substantiate the calculations since the standard deviation of the distribution of electric strengths for built-up insulation is probably not less than 10 per cent.

After the tests the transformer windings were dismantled and closely examined. Insulation breakdowns were found at the line end of the winding and extended for some distance down. The calculated strength curve in Fig. 7 shows this to be the weakest spot, although the change in strength over a large part of the winding is so small that failure might well have originated anywhere in this region. The prediction of both magnitude and position of the minimum surge strength of the winding is thus confirmed as well as may be expected by the tests to destruction.

Conclusion

Until comparatively recently the surge strength of a power transformer winding was known, if at all, only in a vague form from crude tests and a broad summary of operating experience. It is now possible [as shown in Sections 5 to 7 of the paper] to calculate the surge-stress distribution throughout the winding (and the consequent surge strength) for different types and proportions of windings, and for different impulse wave shapes covering most practical conditions. With this knowledge it is possible not only to build a transformer to have any guaranteed surge strength that may reasonably be required, but also to achieve this strength in the most economical way and with the most efficient distribution of insulation.

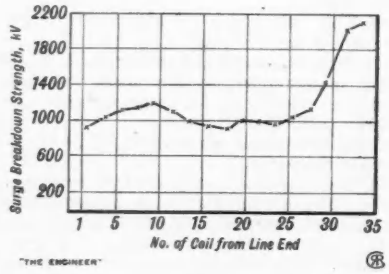
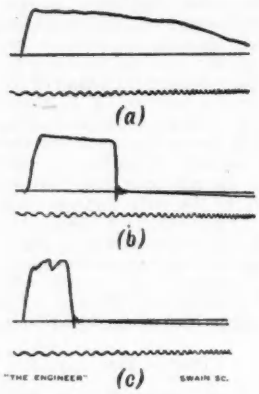


FIG. 7—*Calculated Surge Breakdown Strength of 20,000kVA Transformer*

The two principal methods of improving the lightning strength of power-transformer windings are (*a*) "stress-control" and (*b*) "series-capacitance compensation," one form of which is usually known as electrostatic shielding.

These two methods are not mutually exclusive although they represent different approaches to the problem. It is likely that the optimum design will in general consist of their combination in varying degrees, depending upon the particular technical circumstances and the economics of the case; the latter in turn will depend upon the design technique and manufacturing practice of the individual maker.

It will be clear from the analysis given in the paper that the most effective inter-turn and inter-coil insulation is dependent upon each particular winding design and proportions, and cannot as yet be generalised into a standard specification. It is desirable, therefore, that purchasers should, in future, refrain from stipulating in their specifications particular insulation values for turns and coils [such as those mentioned in Section 10] and that standard specifications such as B.S. 422: 1931 (which has served a useful purpose over many years) should be withdrawn or regarded as obsolete. Assurance to the user of sufficient surge strength can now be given in the more reliable form of guaranteed impulse strengths under standardised testing conditions (e.g., American Standards C.57.1–3, or the draft specification for inclusion in the revision of B.S. 171: 1936).



(*a*) Full wave
(*b*) Chopped wave
(*c*) Chopped wave showing breakdown

FIG. 8—*Cathode Ray Oscillograms of Surge Tests*

Bibliography

[1] Wagner, K. W.: "Das Eindringen Einer Elektromagnetischen Welle In Eine Spule Mit Windungskapazitat," *Elektrotechnik und Maschinenbau*, 1915, 33, page 89.

[2] Blume, L. F., and Boyajian, A.: "Abnormal Voltages within Transformers," *Transactions of the American I.E.E.*, 1919, 38, page 577.

[3] "Surge Phenomena," (British Electrical and Allied Industries Research Association, Ref. S/T35, 1941).

[4] Allibone, T. E., McKenzie, D. B., and Perry, F. R.: "The Effects of Impulse Voltages on Transformer Windings," *Journal I.E.E.*, 1937, 80, page 117.

[5] Norris, E. T.: "Transformer Design," *Electrical Review*, 1931, 108, page 140.

[6] Guillemin, E. A.: "Communication Networks," Vol 2, (Chapman and Hall, 1935), Chap. 11.

[7] Rudenberg, R.: "Performance of Travelling Waves in Coils and Windings," *Transactions of the American I.E.E.*, 1940, 59, page 1031.

[8] Elsner, R.: "Die Gewittersicherheit Moderner Hochspannungstransformatoren," *Elektrotechnik und Maschinenbau*, 1943, 61, page 493.

[9] Rudenberg, R.: "Electric Oscillations and Surges in Sub-Divided Windings," *Journal of Applied Physics*, 1940, 2, page 665.

[10] Gates, B. G.: "The Attenuation and Distortion of Travelling Waves on Overhead Power Transmission Systems at Voltages Below the Corona Limit," *Journal I.E.E.*, 1939, 84, page 711.

[11] Selig, K. L.: "Effect of Humidity on the Surge Performance of a Transformer," E.R.A. Report S/T55.

[12] Miller, J. L., and Thomson, J. M.: "The Surge Protection of Power Transformers," *Journal I.E.E.*, 1939, 84, page 187.

[13] Thomas, H. L.: "Insulation Stresses in Transformers, with Special Reference to Surges and Electrostatic Shielding," *ibid.*, 1940, 84, page 427.

[14] Weed, J. M.: "Prevention of Transient Voltage in Windings," *Transactions of the American I.E.E.*, 1922, 41, page 14.

[15] Norris, E. T.: "Surge Strength of Power Transformers," *Electrical Times*, 1939, 96, page 108.

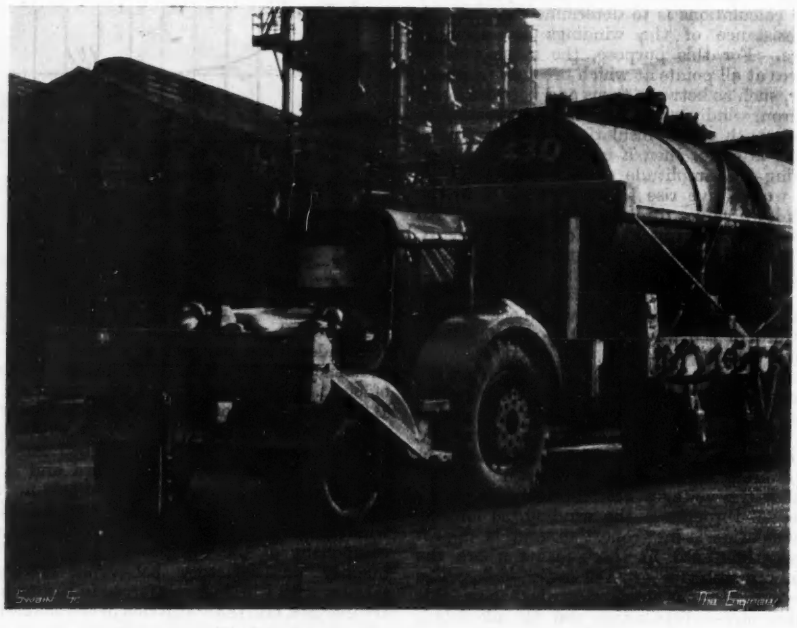
Tractors for Wagon Shunting

We are informed by David Brown Tractors, Ltd., of Meltham, near Huddersfield, that the company's heavy industrial tractors are now being used successfully for railway shunting work in a number of industrial establishments incorporating private yards and sidings.

For this class of work the tractors are fitted with heavy-beam type shunting bumpers, both fore and aft. Their usefulness for general towing and vehicle handling purposes is enhanced by the installation of a winch in the rear. A fairly considerable amount of time is saved in shunting work owing to the fact that these tractors, unlike locomotives, do not have to be manœuvred over crossings and switches when required to work wagons situated on different sets of tracks.

In addition to their primary work of shunting the tractors are used as general works' breakdown vehicles, in which cases their winches can be used to good effect in clearing heavy wreckage or pieces of plant.

We reproduce a photograph of the tractors handling tank wagons in an I.C.I. works. In tests prior to delivery these tractors were required to move loaded wagons totalling 150 tons in weight.



INDUSTRIAL TRACTOR SHUNTING TANK WAGONS

South African Engineering Notes

(By our South African Correspondent)

Union Industrial Development

THE industrial growth of the Union continues to be reflected in news of expansion programmes decided upon by existing firms, and the establishment of new concerns. The Transvaal Steel Pressing Syndicate, Johannesburg, besides the purchase of 25 acres at the New Era Industrial Township, Springs, has also acquired a site at East London, where it is proposed to erect another modern factory. This firm is one of the more progressive in the Union and has a well-earned reputation for the quality and finish of its products. New lines developed since the war cover a wide range of steel goods for industrial and domestic use, and aluminium ware is now also being manufactured. Boulton and Paul (S.A.) (Pty.), Ltd., is planning an extensive engineering and manufacturing programme, including proposals to make household refrigerators and a wide range of wire and netting. It is understood that the firm is also contemplating constructional steel engineering work and woodworking, although wire netting will be the first product to be made. Considerable extensions are now being planned by William Bain and Co. (S.A.), Ltd. The firm is building new structural and plate shops and has completed a new store. A railway siding is now ready, although the company is also putting in two new siding spurs. Heavy cranes and compressors are due to be installed. The Canadian firm, Massey-Harris Company, Ltd., has entered into a collaboration plan with South African Farm Implement Manufacturers, Ltd. (Safim), of Vereeniging. Although this plan has been in operation but a short time, Safim has already entered the world markets as an exporter of farm machinery. The Safim factory at Vereeniging intends eventually to produce almost every type of agricultural machinery, using South African steel, technicians and labour. For the present, Canadian technicians will be introduced into the factory and South Africans will go abroad to new plants to be trained for highly specialised work. Faced with the impossibility of getting adequate supplies of equipment from abroad, many South African firms are now producing plant which is being made in the Union for the first time. South African Wire and General Engineering Company, Ltd., is one of the most active in this field and has just completed six spring-making machines, which are models of machines previously available only from abroad. The company is also building three large automatic chain link machines, which are quite unobtainable to-day and are copies of German equipment.

Aids to Industrial Development

Two items of legislative importance fall to be reported under this heading. The Natural Resources Development Council, for which provision was made in the National Resources Development Act, has been established, according to a recent proclamation in the Government Gazette. The proclamation also establishes regional committees for each of the controlled areas described in the Schedule to the Act, to help the Council perform its function in each of such areas. The Council's purpose is to plan and promote the more effective use of the natural resources of the Union and it will be largely concerned with the development and more rational spread of industries over the country.

The other legislative item refers to the impending change in the character of the Union's National Anti-Waste Organisation, formed during the war. This is soon to be incorporated as a public body and the work which it will undertake will be totally different from that which it undertook during the war. The organisation will deal with the decimalisation of coinage, economy in industry, the prevention of waste in manpower, machines and materials. This drive to make South Africa "efficiency conscious" is expected to have highly beneficial results in all phases of the country's national life.

The Government and Industrial Development

The need for increased development of resources and production and the decentralisation of industry were stressed recently in a speech by Mr. S. F. Waterson, Minister of Mines and Economic Development, during which he gave figures showing what was being done to overtake shortages in the Union. Commenting on the shortages of steel, cement, oils, fats, bags, food and labour, he said these were mainly due to world shortages and could not be overcome by imports. The country was now paying for failing to develop its own resources and must go ahead with increasing its production. Steel production had been increased to 600,000 tons per annum. At the conclusion of hostilities the capital available for steel production had been increased by £22,000,000 to provide for a second steel works, and the industry would produce 1,000,000 tons a year if necessary. Mr. Waterson further stated that coal was the key to the country's production. Before the war, 18,000,000 tons were produced annually, while, during the war annual production rose to 26,000,000 tons and more than eight new mines were opened. By 1949 production would be 31,000,000 tons per annum. South Africa was exporting as much coal as she could but a bottleneck on the railways, due to a shortage of trucks and tracks, had set the limit to such exportation. Referring to industrial expansion, he stressed the value of decentralisation. A country's economy was not balanced if its industries were concentrated in a few localities. The Government's policy was to encourage decentralisation of industry and to promote private enterprise. He revealed that in the last six months oversea industrial concerns had invested about £15,000,000 in South Africa. Industrialists from overseas, who had established industries in the Union, were confident of producing articles, not only for local consumption but also for overseas markets.

Production of Vermiculite

Attention to the potentialities of South Africa as a supplier of vermiculite has been drawn by the contract, recently entered into by a large American firm, to purchase the entire output of certain newly-opened mines in the Northern Transvaal. Vermiculite, the industrial uses of which were first developed in the United States, is an oxidised product of mica, much used for heat and acoustic insulation purposes. It is considered also to have possibilities as a lubricant when used in powdered form in similar manner to that of graphite. A little more than 2000 tons of vermiculite, of which 900 tons went to the United States, was exported from South Africa in a recent quarter. It is hoped soon to export at the rate of 25,000 tons per annum and, when new machinery is installed, to increase this to 180,000 tons.

South African Railways

South African history was made at Salt River when the senior member of the Railway Board, Mr. F. T. Bates, named and handed over for service the first Union-built locomotive. Particulars of this type of locomotive, twelve of which are to be built, were given in the report of September 26th 1947. Mr. Bates stated that the engines were estimated to cost £15,000 each and weighed 144 tons when in full working order. Their completion, said Mr. Bates, would constitute a challenge by the South African Railways engineering administration to the South African engineering industry, a challenge thrown out for the establishment of locomotive works in South Africa. If this challenge was taken up, those responsible for these engines would, he felt sure, not stop there, but would desire to improve on their performance, perhaps by designing and building the type of engine used on South African goods and passenger trains. He hoped that such an ambition would be supported by the Railway Administration because of the expansion now taking place in its workshop. Those workshops were being extended and developed on the most modern lines, so that their capacity to undertake such work would be greatly increased. Although there had been a trickle of locomotives from overseas, the Union's requirements from that source were still largely unfulfilled, so that the twelve engines would be a valuable addition to the Administration's motive power, which at present was strained to the utmost to provide sufficient haulage to meet the country's evergrowing demand for transport. Mr. Bates stated that the present programme provides for 387 steam locomotives, of which 286 still remain to be placed in service. This is apart from provision which is to be made in 1948–49 estimates for 100 more locomotives. During 1917, there were 1518 engines in service and in 1947 the number had risen to 2333.

Electricity for Rural Areas

Eight large schemes for supplying rural areas near Pretoria with electricity at a total cost of about £500,000 are now being considered by the Pretoria Municipal Electricity Department. The total area concerned is about a third of that which the City Council was recently authorised to supply by the Electricity Supply Control Board. Though the schemes are now under consideration, it will probably be two or three years before all the consumers in these areas are supplied, because of difficulties in obtaining equipment, and shortage of technical staff. Transformers are still difficult to obtain, even though South Africa is now making her own, and difficulties in the British and American ceramics industries are holding up the manufacture of high voltage insulators. In all the schemes the department will follow the modern American and British practice of using a single-phase system.

Vanderbijl Engineering Corporation

Progress made in the last fifteen months towards the erection and placing into operation of the heavy engineering works of "Vecor" and the results which have so far been achieved may, according to Dr. H. J. van der Bijl, be regarded as satisfactory, in spite of the difficult circumstances which have prevailed since a start was made some twenty months ago in the construction of the Vecor Works on the bare veldt. The machine shop building is now complete and the bulk of the machine tools have been installed. This building, which covers an area of approximately 2½ acres, is designed on the most modern lines and there can be few, if any, stated Dr. van der Bijl, heavy engineering shops in the world having a better lay-out or more modern equipment. This shop was put into initial operation at the beginning of February of this year, when a modest start was made with a few skilled artisans and a number of learner machinists. In September, 1947, the shop came into full production, working two full shifts a day. The foundry is now nearing completion and it is anticipated that production here will commence within the next two or three months. The ancillary shops, viz., forge shop, pattern shop, stores, &c., are all completed and practically the whole of the original works scheme is now nearing completion and should reach full production during the course of 1948. During the course of the year it became apparent to the company that the original works scheme did not make sufficient provision for all the work which could and should be undertaken in South Africa. In this regard it became obvious that the establishment of a fabrication welding shop had become a matter of urgent necessity. Arrangements have therefore been made to proceed with the construction of such a shop. The company is also giving consideration to the question of establishing a heavy "precision" shop, capable of tackling such work as turbines and certain mechanical parts of heavy electrical equipment. Investigations in this connection, however, will take some time before conclusions can be reached.

Industrial and Labour Notes

The T.U.C. and Wages Policy

Following the Prime Minister's statement on Personal Incomes, Costs and Prices, the special committee of the T.U.C. General Council, which has been investigating matters relevant to the economic situation, held a meeting on Thursday of last week. It was stated afterwards that the committee gave detailed consideration to the contents of the White Paper in their bearings upon the interrelated questions of prices, profits, production costs and wage standards in different industries, and that it was in general agreement with the declared aim of the Government's policy to avoid inflation.

In view, however, of the far-reaching implications involved and the effects of the Government statement upon the position of the unions and their wage negotiations, the committee concluded that consultation with the Prime Minister and some of his colleagues was necessary before the T.U.C. General Council could be in a position to give guidance to the affiliated unions. It was therefore decided to ask the Prime Minister to receive a deputation from the T.U.C. for an "immediate clarification of the serious difficulties arising out of the implication of the Government's statement."

It is reported, as we go to press, that a deputation from the T.U.C. special committee was received by the Prime Minister on Wednesday.

The National Joint Advisory Council

A meeting of the National Joint Advisory Council, which consists of representatives of the British Employers' Confederation and the Trades Union Congress, was held under the chairmanship of the Minister of Labour on Wednesday of last week. Among the reports submitted to the Council was one which indicated that the Control of Engagement Order, 1947, had had a considerable effect in reducing wastage from important industries and fostering transfer to such industries. It was also stated that workers had been willing to be guided into essential employment, that the number of directions issued had been negligible, and that very few infringements of the Order had been reported.

Another matter discussed by the Council was electricity supply and the staggering of working hours. It was reported that the Electricity Sub-Committee had considered whether the time had arrived when a recommendation could be made as to the date on which staggering could be relaxed for the summer months. The sub-committee, it was stated, was firmly of the opinion that staggering would be absolutely necessary in the winter months, but thought that it might well be relaxed as soon as possible for the duration of the summer. It was suggested, therefore, that the Regional Boards for Industry should be informed at once that they were authorised to proceed on the assumption that there would be relaxation as from a specified date, so that they could prepare to suspend the special staggering arrangements from then until October.

Finally, the White Paper on Personal Incomes, Costs and Prices was presented to the Council. The Minister of Labour stated that it was intended to give the document the widest possible publicity by distribution to trade unions and employers' organisations and by all other available means.

The Royal Ordnance Factories

The Government's policy regarding the Royal Ordnance Factories was outlined by the Minister of Supply, Mr. G. R. Strauss, at a meeting of the Ministry of Supply Joint Industrial Council, which was held in London on Wednesday of last week.

In the course of his speech, the Minister said that it had been the general policy of the Government to discontinue, as far as possible, the demands of the Services on private industry. The continuing requirements of the Services for munitions were now relatively small and in dealing with them maximum allocations had been made to the Royal Ordnance Factories. This year, for instance, it was reckoned that about £12,000,000-worth of work for the Services would be undertaken by the Royal Ordnance Factories, and in addition they had £12,000,000-worth of civilian orders outstanding. It had been suggested, the Minister continued, that the factories should build up lines of civil work, which might be relied upon to provide lasting activity and there were now several lines of civil work, such as wagons, sleepers, ceramics, oilfield equipment, and various types of machinery, which offered prospects of establishing themselves.

For their war potential, as for their economic usefulness to the nation, Mr. Strauss said, the Royal Ordnance Factories must be kept as active concerns, with a healthy complement of workers. The permanent establishment of a proportion of workers was already under consideration, and his purpose would be to seek for the factories every kind of alternative work which they could properly undertake. With regard to labour, Mr. Strauss stated that the present strength of the Royal Ordnance Factories was 39,600 and for the near future it was likely to be maintained at much the same level. That did not mean that there would be no fluctuation, as some factories would present their special difficulties, which could not be overcome at once. Over the factories as a whole, however, it was not expected that the total employment would vary by as much as 10 per cent.

In conclusion, the Minister said that he fully accepted the view that maximum alternative civil work should be undertaken in the Royal Ordnance Factories. Within the realistic limits set by present economic needs, he intended that his department should pursue the policy of alternative work with all possible vigour.

Rates of Wages

The Ministry of Labour has now issued some detailed statistics indicating the changes in wage rates which occurred in the principal industries of the United Kingdom during 1947. It is estimated that, at the end of last year, the average level of full-time weekly rates of wages in all the industries for which information is available was nearly 5 per cent higher than at the end of 1946, and about 73 per cent higher than at September, 1939. Altogether, in 1947, approximately 4,942,000 workpeople received increases in wage rates which aggregated £1,726,500 a week.

In several industries, the length of the normal working week was reduced during last year without there being any corresponding reduction in weekly rates of wages. This, of course, had the effect of increasing hourly rates of wages, and the Ministry estimates that the increase in hourly rates in 1947 was between 9 and 10 per cent on 1946, making a total increase since September, 1939, of approximately 84 to 85 per cent. It should be noted that these percentage increases in weekly and hourly rates of wages take no account of increases in average earnings, which have resulted since the beginning of the war from other factors such as fuller employment, overtime working, and the extension in some industries of systems of payment by results.

Among the industries in which wage increases became effective last year were coal mining, building and civil engineering contracting, the railway service, certain sections of the iron and steel industry, and the gas and electricity supply industries. Industries in which there was no general change in wage rates during 1947 included the engineering and allied and other metal trades, shipbuilding and repairing, road goods and passenger transport, and the port transport (dock labour) industry.

Nationalised Industry

The Lord President of the Council, Mr. Herbert Morrison, spoke on the socialisation of industry at a meeting in London last week end, and stated that most of the industries at present nationalised had been placed under the control of public corporations independent of the Government in matters of day-to-day administration. Asserting that nationalisation was a "means to an end," Mr. Morrison said that the Government was trying to secure better public service, greater efficiency and economy, and the wellbeing and dignity of all workers.

Mr. Morrison went on to say that in the field of fuel and power it would be possible to work out a policy for cheaper and plentiful electricity supplies. Cheap electricity must be brought to rural areas, which had in the past been starved to a large extent because supply companies, with one or two exceptions, had looked to quick profits, and had been unwilling to undertake long-term development work. Between gas and electricity an attempt would be made to maintain the necessary element of healthy emulation.

On the subject of prices, Mr. Morrison claimed that, in the past, the private monopolist, whether a railway company or an electricity supply undertaking, had been inclined to extract what he could from each class of consumer. That, however, was not the right basis of charging from the national point of view, and all the industries which had been nationalised must get down very soon to the matter of prices and charges.

Working Hours

In presenting figures relating to hours of labour in 1947, the Ministry of Labour has explained that since the widespread reduction in the years 1919 and 1920, there was comparatively little movement until 1946, when about 2,100,000 workers had their hours of work reduced. The reductions continued throughout last year, and it is estimated that, on the average, about 5,200,000 workpeople in this country had their normal working week shortened by approximately three and a half hours.

In the coal-mining industry the normal working week, which had formerly varied according to district, was reduced in May for underground workers to five consecutive shifts of seven and a half hours each, plus one winding time, and for surface workers to 42½ hours, to be worked in five consecutive shifts of eight and a half hours. It will be recalled however, that before the end of the year, coal miners had begun to work additional hours for which overtime rates became payable.

In the engineering, shipbuilding and ship-repairing industries, the normal working week was reduced in 1947 from 47 to 44 hours, and in civil engineering construction, the average working week of 48 hours was reduced to 44 hours. Workers, other than shift workers, in gas undertakings had their hours reduced from 47 to 44 a week, and in the electricity supply industry the normal hours of shift workers were reduced from 48 to 44 a week, and those of dayworkers declined from 47 to 44. The hours of railway workers in Great Britain and of those employed in the road haulage of goods were reduced from 48 to 44 a week, and the normal working week of employees in road passenger transport undertakings fell from 48 or 47 to 44 hours.

French Engineering News

(From our French Correspondent)

There is still a minimum delay of five to six months in deliveries of wire due to the insufficient steel supplies allocated to the industry, and despite the development of production capacity which is considerably higher than in 1938. Since demand inside France cannot be adequately met, export orders are almost out of the question for the moment. For special steel wire for electrical use, for example, the delay is twelve months. For cold rolled and drawn goods, allocations of crude steel are much larger, but demands are so great that delivery delays are six to eight months for the latter and ten to twelve months for the former.

* * *

Modernisation of the Nord and Pas de Calais nationalised mines is still proceeding. Compressors, totalling 49,900 h.p. have been ordered from America, and a broad programme of mechanisation is in course of completion. The shortage of S.N.C.F. rolling stock has led to an order for forty-two 50-ton locomotives, of which thirty-three are already in service, and fifteen 36-ton locomotives, of which thirteen are in service, as well as 1710 wagons. Four coking batteries were ordered in 1946 and 1947. Electrical equipment ordered includes three 40,000-kW sets and a complete plant of two sets of 62,500-kW each, which are now being installed.

* * *

Although the consumption of electric power in the mining and metal industries varies widely according to the nature of the products mined or manufactured and according to local conditions, it is interesting to note the average figures which are obtained from examining a series of industries. Average consumption of electricity for coal mining, for example, is 62kWh a ton, compared with 40 or 50kWh in 1939. This increase is due to the more general use of electricity not only for hewing and compressors, but also for ventilation and mechanical handling. Consumption in the slate quarries for extraction and manufacture averages 80kWh per ton. It varies between 3·5kWh and 6kWh a ton for quarry stone. Portland cement requires 80 to 100kWh per ton. The following figures are recorded for the steel industry: Thomas steel 60kWh; steel ingots, 200kWh; commercial steel, 180 to 490kWh; plate, 370kWh and sheet, 620kWh. Non-ferrous metal foundries use between 160 and 170kWh per ton, and for zinc rolling the figure is about 120kWh per ton. The increasing use of electricity has resulted in increased volume of production, improved quality and an appreciable reduction in the labour employed and costs.

* * *

Following the recent London conversations between French and British representatives of the coal and steel industries, a further meeting is to be held in Paris in February after the Geneva meeting of the European Coal Committee. At the moment, France is in no position to establish an export programme for semi-finished steel products in exchange for British coal, as she needs to be assured of an annual home production of eight to ten million tons, which is dependent on her coal and coke supplies. Once more, France contends that German coal from the Ruhr should be sent to work French ore rather than vice versa, and that the means for exports of steel to Britain therefore lie in Britain's hands.

* * *

The French tractor production programme for 1948 has been fixed at 16,000. Some 6200 tractors will be imported, making a total of 22,200 for the year, as against 60,000 laid down by the Monnet plan. Harry Ferguson, Ltd., of Coventry, it is understood, will send France 5000 tractors before the end of June, each equipped with a plough, if possible. It is learned that by arrangement with the Standard Motor Company, Ferguson has been able to reduce the price of tractors to France by 12 per cent. Reaction here is very favourable and the gesture has done much for British trade in France.

Notes and Memoranda

Rail and Road

C.P.R. Equipment.—Orders have been placed by the Canadian Pacific Railway for new equipment including 44 diesel locomotives, 2100 freight wagons and 115 passenger coaches. Together with uncompleted orders from previous years, this brings to more than 63,000,000 dollars the value of motive power and rolling stock contracts outstanding.

Shunting Locomotives for London Midland Region.—An order for five 0–4–0 standard gauge diesel-mechanical locomotives of 137/150 b.h.p., for shunting duties at engineer depots in the London Midland Region of British Railways has been placed with John Fowler (Leeds) Ltd. The locomotives are intended for use at the Beeston (Notts) and Ditton (Liverpool) sleeper depots, and at the Lenton (Notts), Northampton, and Castleton (Lancs) centralised permanent way material depots, all of which are under the jurisdiction of the Chief Civil Engineer, London Midland Region.

Strengthening a Leicestershire Viaduct.—A contract for the strengthening of one of the arches of the thirteen-span brick viaduct supporting the Market Harborough—Melton Mowbray line of British Railways at East Norton, Leicestershire, has been placed with Wellerman Bros., Ltd., of Sheffield. The viaduct, which is at present in need of repair owing to the effects of end-thrust from the adjoining embankment, will be strengthened by the sinking of thirty reinforced concrete pressure piles in front of two of the existing piers. In addition, the defective arch will be strengthened by means of a new brick arch, supported on two large and heavy piers, to be constructed immediately beneath the defective arch. The space between the existing and supporting arches will then be filled with hand packed rubble which will be grouted with cement. It is expected that the work will be completed within twelve months.

Air and Water

Swedish Shipping.—Swedish-owned shipping last year reached a total of 1,900,000 tons, an increase of 10 per cent over 1946, and 300,000 tons more than in 1939.

Inland Water Transport.—The Minister of Transport stated recently that there were, in Great Britain, approximately 2400 miles of navigable canals and locked river navigations, as compared with 2700 miles in 1939.

Canadian Air Survey.—Hundreds of air photographs taken last spring by using two converted Anson trainer aircraft are being pieced together in the laboratories of the Photographic Survey Company, Ltd., a Canadian company of the Hunting Aviation Group. When completed they will form a mosaic picture, with an area of 529 square feet, of the entire city of Toronto. The picture, which is being assembled by eight technicians, is required by Toronto community planners as a base map for use in planning projects now under consideration.

Metal Recovery Depot Closing.—The Minister of Supply announces that the recovery of secondary aluminium ingot from crashed aircraft scrap, which has been carried on since 1943 under the management of Morris Motors, Ltd., at No. 2 Metal and Produce Recovery Depot at Eaglescliffe, Co. Durham, will come to an end at that depot at the end of March or the beginning of April. Aircraft scrap recovery has progressed so far that there is no longer enough scrap to keep the depot in operation. It is expected that the salvage and disposal of other aircraft material now lying at the Depot will continue for some months more.

Miscellanea

World Engineering Conference.—The first annual general meeting of the British Section of the World Engineering Conference is to be held at the Institute of the Motor Industry, 40, Queen's Gate, London, S.W.7, on Wednesday, February 18th, at 2.30 p.m. The report of the provisional British Committee for the year 1947 will be presented.

Society of Engineers.—The Society of Engineers has made the following awards for papers presented during its last session:—Simms Gold Medal to Mr. J. G. Milton, M.I.Mech.E., for his paper on "Research and New Developments in Water Treatment"; Bessemer Premium to Mr. C. D. Mitchell for his paper on "Prefabricated Pre-Cast Concrete Structures"; Nursey Premium to Mr. R. Cecil Smart, for his paper on "Industrial Organisation as a Factor in Productive Efficiency," and a Bernays Premium to Mr. B. Payne, for his paper on "Water Supply Engineering."

Public Health and Municipal Engineering Exhibition.—For the first time for ten years, a Public Health and Municipal Engineering Congress and Exhibition is to be held at Olympia, London, from November 15 to 20, 1948. The exhibition will include equipment for every branch of the public service, such as water, gas and electricity supply, drainage, cleansing, refuse disposal, quarrying, road-making and municipal transport.

Retirement of Mr. H. R. Brett.—After twenty-one years as London Advertisement Representative of The Engineer, Mr. Harold Russell Brett has retired. During this period of loyal service to this journal, Mr. Brett has become well known to many of our readers and advertisers, and we feel sure that they will join with us in wishing him health and happiness in his retirement. Mr. D. J. Tribe succeeds Mr. Brett as a member of our London advertising staff.

Waste Paper Drive.—Following an appeal made in Parliament on January 30th by the President of the Board of Trade, the Waste Paper Recovery Association announces a drive to collect an additional 100,000 tons of paper by July. The purpose of the campaign is to save expenditure of dollars on paper and paper-making materials from North America, the collection of 100,000 extra tons in six months being equivalent to a saving of 10,000,000 dollars, and also to maintain supplies of paper and cardboard, essential for the packing and protection of export goods, and for home food distribution. The Association suggests that there should be a thorough spring cleaning of cupboards and desks in every home, office, warehouse and factory, without delay. All unwanted paper and cardboard should be cleared out, bundled, kept clean and given to the salvage collector for immediate return to the mills for pulping and remanufacture.

Surface Finishing of Aluminium.—The Aluminium Development Association has recently issued a pamphlet dealing with "Surface Finishing of Aluminium and its Alloys." It is No. 13 in the series of Information Bulletins, and opens with a section describing processes of cleaning and degreasing aluminium and aluminium alloy surfaces before finishing, the importance of thorough preparation in order to give successful results being emphasised. The finishing processes proper are divided into four groups, mechanical processes, chemical processes, electro-plating, and paint finishes. The mechanical processes are the well-known ones, such as grinding, sand and shot blasting, scratch brushing, barrel polishing, and hammer finishing, but here as in other sections, modifications made necessary by the characteristics of the materials are clearly indicated. Among other matters included in the pamphlet, electro-plating is dealt with fairly fully. Special surface preparation is described, after which are given the plating solutions and conditions of treatment to produce the many coatings that can be applied to aluminium surfaces. The bulletin also contains a selected bibliography and lists of relevant official specifications.

"Journal" of the Institute of Navigation.—We have received from the Institute of Navigation, at the Royal Geographical Society, 1, Kensington Gore, London, S.W.7, a copy of the first issue of the Institute's *Journal*, published by John Murray, of 50, Albemarle Street, London, W.1, price 6s. There are in it several interesting articles, including the following:—"The Development of Navigation," by Sir Harold Spencer Jones, F.R.S., Astronomer Royal; "Air Navigation and the New Institute," by Air Chief Marshal Sir John Slessor; "The Boundaries of Pure Science and Navigation," by Sir Charles Darwin, F.R.S., and "Radio Aids to Navigation," by Sir Robert Watson Watt, F.R.S. Mr. D. H. Sadler writes on "Altitude Correction for Coriolis Acceleration"; Mr. A. H. Jessel, B.Sc., on "Consol"; and there are four papers on "Pressure Pattern Flying." Mr. Francis Chichester discusses "What is the Ideal Map," and Lieut. R. B. Mitchell, R.N., contributes an article on "The Second L.M.R.A.M.N." Lieut. P. G. Satow, R.N., deals with "The Ocean Weather Service," Air Vice-Marshal D. C. T. Bennett with "The Navigational Aspect of Height Refuelling," and Group Captain H. E. C. Boxer with "Navigation in Automatic Flight." A record of the activities of the Institute with the personnel of the provisional council and committees is given, and there is also an account of the American Institute and its last year meetings. The volume closes with reviews of books and correspondence. Subsequent issues are expected to contain contributions of scientific value, but the first number of the *Journal* naturally contains a good deal about the Institute itself.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

Saturday, Feb. 14th.—ST. ALBANS BRANCH: The Peahen Hotel, London Road, St. Albans. "Refrigeration as Applied to Industry," W. Boag. 3 p.m.

Monday, Feb. 16th.—CENTRAL LONDON BRANCH: St. Ermin's Hotel, Caxton Street, S.W.1. "Post Office Engineering during World War II," A. C. Timmis. 6.40 p.m.

Tuesday, Feb. 17th.—Lighting Service Bureau, 2, Savoy Hill, W.C.2. "Critical Temperatures Control in Domestic and Industrial Processes," F. E. Butcher. 6.15 p.m.

Wednesday, Feb. 18th.—COVENTRY BRANCH: Technical College, The Butts, Coventry. "High Voltage Fluorescent Tubes." 7 p.m. — MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester. "Electrode Boilers," S. Lees. 7 p.m.

Thursday, Feb. 19th.—PORTSMOUTH BRANCH: Talbot Hotel, Southsea. "X-Rays and X-Ray Equipment," W. E. Gladwish. 6.30 p.m.

Bradford Engineering Society

Monday, Feb. 16th.—Technical College, Bradford. "History and Development in the Making of Steel Wire," R. S. Brown. 7.15 p.m.

Diesel Engine Users Association

Thursday, Feb. 19th.—Caxton Hall, Caxton Street, S.W.1. Informal Discussion. 2.30 p.m.

Hull Chemical and Engineering Society

Wednesday, Feb. 18th.—Royal Station Hotel, Hull. "Deep Sea Diving," C. E. T. Warren. 7.30 p.m.

Incorporated Plant Engineers

Wednesday, Feb. 18th.—BRISTOL BRANCH: Grand Hotel, Bristol. "Measurement as the Basis of Progress," E. C. Mills. 7.15 p.m.

Thursday, Feb. 19th.—LIVERPOOL BRANCH: The Temple, Dale Street, Liverpool. "Alternating Current and Motors," N. Clarkson. 7.30 p.m.

Institute of British Foundrymen

To-day, Feb. 13th.—MIDDLESBROUGH BRANCH: Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. "The Influence of Production Flow on Moulding Methods in Iron Foundries and its Effects on P.M.H. and General Efficiency," R. C. Shepherd. 7 p.m.

Saturday, Feb. 14th.—BRISTOL AND WEST OF ENGLAND BRANCH: Grand Hotel, Broad Street, Bristol. "Roller Conveyor and its Application to the Foundry," J. Gardom. 3 p.m.—NEWCASTLE BRANCH: Neville Hall, Newcastle-upon-Tyne. "Some Practical Aspects of Bronze Founding," F. C. Evans. 6 p.m.—SCOTTISH BRANCH: Royal Technical College, George Street, Glasgow. "The Constant Charge Method of Cupola Operation," W. W. Braidwood. 3 p.m.

Thursday, Feb. 19th.—LINCOLN SECTION: Technical College, Lincoln. "Venting of Cores and Moulds," D. Killingworth. 7.15 p.m.

Institute of Marine Engineers

Wednesday, Feb. 18th.—JUNIOR SECTION: Merchant Venturers' Technical College, Bristol. "The Combustion Turbine," J. Calderwood. 7 p.m.

Institute of Navigation

Friday, Feb. 20th.—Royal Geographical Society, 1, Kensington Gore, S.W.7. "Radar and the Weather: Problems in Marine Navigation," P. G. Satow. 5.30 p.m.

Institute of Welding

Wednesday, Feb. 18th.—NORTH LONDON BRANCH: South-West Essex Technical College, Walthamstow. Question Night. 7.30 p.m.

Thursday, Feb. 19th.—SOUTH LONDON BRANCH: County Technical College, Guildford. Discussion on "Methods of Welding Cast Iron." 6.30 p.m.

Institution of Chemical Engineers

To-day, Feb. 13th.—Institution of Civil Engineers, Great George Street, S.W.1. "Developments in the Industrial Production and Use of Gaseous Oxygen." 10 a.m. to 12 noon, 2 p.m. to 5 p.m.

Institution of Civil Engineers

Tuesday, Feb. 17th.—Great George Street, S.W.1. "Tidal Power: Its Development and Utilisation," B. D. Richards. 5.30 p.m.

Thursday, Feb. 19th.—BIRMINGHAM AND DISTRICT ASSOCIATION: The College, Loughborough. "Some Aspects of Hydro-Electric Development with Special Reference to the Scottish Highlands," N. J. Cochrane. 7 p.m.

Institution of Electrical Engineers

Saturday, Feb. 14th.—NORTH MIDLAND STUDENTS' SECTION: Electricity Showrooms, Ferensway, Hull. "Current Transformers," A. R. Rumfitt. 2.30 p.m.

Thursday, Feb. 19th.—ORDINARY MEETING: Savoy Place, Victoria Embankment, W.C.2. "The Design of Large Vertical-Shaft Water-Turbine-Driven a.c. Generators," E. M. Johnson and C. P. Holder. 5.30 p.m.

Friday, Feb. 20th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1. "The Corrosion of Heating Surfaces in Boiler Plants," J. R. Rylands and J. R. Jenkinson. 5.30 p.m. —MEASUREMENTS SECTION: Savoy Place, Victoria Embankment, W.C.2. "Absolute Measurement of High Voltages by Oscillating Electrode Systems," E. Bradshaw, S. A. Husain, N. Kesavamurthy, and K. B. Menon. 5.30 p.m.

Institution of Engineers-in-Charge

Wednesday, Feb. 18th.—E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, Strand, W.C.2. "The General Trend in Modern Lighting," W. R. Robinson. 6.30 p.m.

Institution of Mechanical Engineers

To-day, Feb. 13th.—Storey's Gate, St. James's Park, S.W.1. "Torsional Fatigue Testing of Marine Shafting," S. F. Dorey. 5.30 p.m.—EAST MIDLANDS BRANCH: Technical College, Lincoln. "Applications of Electricity to Agriculture," W. Cover. 7.15 p.m.

Saturday, Feb. 14th.—NORTH WESTERN BRANCH, GRADUATES' SECTION: Engineers' Club, Albert Square, Manchester. Annual Luncheon. 12.30 p.m.—WESTERN BRANCH, GRADUATES' SECTION: Visit to the Fitting-out Basin and Docks of Charles Hill and Sons, Ltd., Albion Dockyard, Bristol Docks, Bristol. 10 a.m.

Monday, Feb. 16th.—GLASGOW AUTOMOBILE DIVISION: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow. "Springs for Automobile Suspension," B. Mackenzie. 7.30 p.m.

Wednesday, Feb. 18th.—LONDON GRADUATES' SECTION: Visit to *Daily Telegraph* newspaper offices. 9 p.m.

Thursday, Feb. 19th.—MIDLAND BRANCH: James Watt Memorial Institute, Great Charles Street, Birmingham. "The Manufacture of Seamless Steel Tubes," J. W. Jenkin. 6 p.m.—BRISTOL AUTOMOBILE DIVISION: Grand Hotel, Bristol. "Public Service Vehicles," D. M. Sinclair. 6.45 p.m.—DERBY AUTOMOBILE DIVISION: School of Arts, Green Lane, Derby. "The Organisation of Large-Scale Vehicle Overhaul and Repair," E. C. Ottaway. 7 p.m.

Friday, Feb. 20th.—Storey's Gate, St. James's Park, S.W.1. "Corrosion of Heating Surfaces," J. R. Rylands and J. R. Jenkinson. 5.30 p.m.

Institution of Mining and Metallurgy

Thursday, Feb. 19th.—Geological Society, Burlington House, W.1. "The Development and Introduction of a New Process for the Economic Recovery of Minute Quantities of Gold from Lead-Silver Bullion Derived from the Bawdwin Ores," W. Frayne; "Notes on Labour Organisation and Performance at the Badhia Mine, Indian Copper Corporation, Ltd.," A. L. Austen. 5 p.m.

Institution of Production Engineers

Saturday, Feb. 14th.—MANCHESTER GRADUATE SECTION: College of Technology, Sackville Street, Manchester. "Hydraulics," H. C. Town. 7.15 p.m.

Sunday, Feb. 15th.—DERBY SUB-SECTION: Art School, Green Lane, Derby. "The Structure of Management," G. E. Cheliotti. 6.45 p.m.

Wednesday, Feb. 18th.—WOLVERHAMPTON SECTION: Wolverhampton and Staffs. Technical College, Wolverhampton. "Plant Maintenance," D. Bailey. 7 p.m.—BIRMINGHAM SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham. "Some Measurements of British and American Industrial Efficiency," Lewis C. Ord. 7 p.m. —WESTERN SECTION: Grand Hotel, Bristol. "Manufacture of Ball and Roller Bearings," R. L. Tardy. 7.15 p.m.—LIVERPOOL SUB-SECTION: The University, Liverpool. "Production Welding in the Workshop," A. E. Griffin. 7.15 p.m.—LUTON AND DISTRICT GRADUATE SECTION: Midland Hotel, Luton. "Production Control," A. H. Huckle. 7.30 p.m.

Thursday, Feb. 19th.—GLASGOW SECTION: Institute of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow. "Drop Forging," J. Douglas Latta. 7.30 p.m.—LEICESTER SECTION: College of Technology, The Newarke, Leicester. "Malleable Castings: Applications in Engineering and Machine Shop Practice," W. E. Marshall. 7 p.m.

Friday, Feb. 20th.—EASTERN COUNTIES SECTION: Electric House, Ipswich. "Cold Upsetting and Thread Rolling," T. C. Parker. 7.45 p.m.

Institution of Structural Engineers

To-day, Feb. 13th.—LANCASHIRE AND CHESHIRE BRANCH: College of Technology, Manchester. "Timber as an Engineering Material," Phillip O. Reece. 7 p.m.

Wednesday, Feb. 18th.—LONDON GRADUATES' AND STUDENTS' SECTION: 11, Upper Belgrave Street, S.W.1. "Modern Trends in Structural Welding," O. Bondy. 6 p.m.—YORKSHIRE BRANCH: Great Northern Hotel, Leeds. "Timber Construction," E. H. Nevard. 6.30 p.m.

Friday, Feb. 20th.—LANCASHIRE AND CHESHIRE BRANCH, GRADUATES' AND STUDENTS' SECTION: Milton Hall, Deansgate, Manchester. "The Manchester Plan," J. P. Bamber. 7 p.m.—WESTERN COUNTIES BRANCH, GRADUATES' AND STUDENTS' SECTION: Merchant Venturers' Technical College, Bristol. "Surveying Instruments and Their Construction," E. F. Gibbs. 7 p.m.

Junior Institution of Engineers

To-day, Feb. 13th.—39, Victoria Street, S.W.1. "A Passenger Chassis for Service in India," W. J. Kease. 6.30 p.m.—SOUTH MIDLAND GROUP OF MEMBERS: Technical College, Park Square, Luton. "The General Application of Measuring Instruments to Industry," C. W. Terry. 7.30 p.m.

Monday, Feb. 16th.—NORTH-WESTERN SECTION: Manchester Geographical Society, 16, St. Mary's Parsonage, Manchester. "Modern High Pressure Steam Boilers," G. Cooke. 7 p.m.

Friday, Feb. 20th.—39, Victoria Street, S.W.1. "Ferranti and His Engine Designs," W. H. Wyatt-Millington. 6.30 p.m.

Keighley Association of Engineers

Friday, Feb. 20th.—Devonshire Buildings, Devonshire Street, Keighley. "Precision Machine Tools," J. E. Hill. 7.30 p.m.

Manchester Association of Engineers

Friday, Feb. 20th.—Engineers' Club, Albert Square, Manchester. "Hard Metal in Industry," G. J. Trapp. 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders

Friday, Feb. 20th.—Mining Institute, Newcastle-upon-Tyne. "The Analysis and Interpretation of Vibration Records and Similar Traces in Engineering," R. G. Manley. "Ship Vibration," F. H. Todd and W. J. Marwood. 6.15 p.m.

Sheffield Metallurgical Association

Tuesday, Feb. 17th.—198, West Street, Sheffield, 1. "The Analysis of Permanent Magnet Alloys," G. Murfitt. 7 p.m.

Societe des Ingenieurs Civils de France

Thursday, Feb. 19th.—BRITISH SECTION: Institution of Civil Engineers, Great George Street, S.W.1. "The Reconstruction of Railway Bridges in France," L. Carpentier. 5.30 p.m.

Society of Engineers

Friday, Feb. 20th.—INFORMAL SECTION: 17, Victoria Street, S.W.1. "Technical Education," L. J. Merry. 6.30 p.m.

West of Scotland Iron and Steel Institute

To-day, Feb. 13th.—39, Elmbank Crescent, Glasgow. "The Application of Fuel Oil and Surplus Gas at the Irlam Works of the Lancashire Steel Corporation, Ltd.," J. Sinclair Kerr. 6 p.m.

Friday, Feb. 20th.—39, Elmbank Crescent, Glasgow. Informal Discussion on "Open Hearth Furnace Design," opened by A. M. McKendrick. 6.45 p.m.

Women's Engineering Society

Monday, Feb. 16th.—LONDON BRANCH: 35, Grosvenor Place, S.W.1. "Reclamation and Reconditioning of Worn Parts by Oxy-Acetylene Welding," F. Clark. 7 p.m.

Personal and Business

MR. W. HOWES has succeeded Mr. C. Green as President of the Diesel Engine Users Association.

T. M. BIRKETT and SONS, Ltd., Hanley, and Billington and Newton, Ltd., Longport, announce that they have amalgamated.

THE RICHARD CRITTALL GROUP has formed a separate company named Richard Crittall Marine, Ltd., to deal with marine installations.

THE ORDNANCE CONSULTING OFFICER FOR INDIA states that his address is now 4, Central Buildings, Matthew Parker Street, London, S.W.1 (telephone, Whitehall 2166).

THE SOUTH-EAST SCOTLAND ELECTRICITY BOARD has appointed Mr. T. R. Warren, M.I.E.E., to be chief engineer. Mr. T. J. Mullan has been appointed secretary to the Board.

THE ALUMINIUM PLANT AND VESSEL COMPANY, Ltd., announces that the necessary sanction is being obtained to change its formal title to The A.P.V. Company, Ltd.

MR. R. FERGUSON, M.I.Mech.E., has been appointed consultant director to F. Perkins, Ltd. Mr. A. Griffiths has been appointed a director and general manager of the company.

VICKERS-ARMSTRONGS, Ltd., has acquired from American Type Founders, Inc., the sole manufacturing and selling rights in this and other countries of the Kelly letter press.

JAMES LIGHT AND SON, Ltd., announces that its London address has been changed to 43–44, Hythe Road, Willesden, N.W.10 (telephone, Ladbroke 3425; telegrams, Liadgo, Phone, London).

MR. J. P. PORTER, B.Sc.(Eng.), M.I.C.E., of the Chief Engineer's Department, London County Council, has been appointed Chief Engineer to the Auckland, New Zealand, Metropolitan Drainage Board.

E. H. JONES (MACHINE TOOLS), Ltd., announces that it has established a research department in its export division, under the control of Mr. C. F. Brook. The company is also setting up an automatics technical department under the direction of Mr. T. J. Corcoran.

MR. A. T. PRIDDLE has been appointed a director and joint general manager of C.A.V., Ltd. Mr. D. C. Burton, A.M.I.Mech.E., has recently joined the company's technical staff as experimental engineer, responsible for diesel equipment development and engine testing.

THE COLONIAL OFFICE announces the following appointments: Captain W. S. Adams, executive engineer, Public Works Department of Nigeria; Mr. I. C. Gillespie, assistant engineer, Railway Department, Nigeria; and Mr. D. W. Walker, mechanical and electrical engineer, Public Works Department, Uganda.

THE NORTHERN ALUMINIUM COMPANY, Ltd., states that its Birmingham sales office has been moved to 14, Temple Street, Birmingham, 2 (telephone, Midland 5236; telegrams, "Noralumin, Birmingham"), and that its south-western area sales office is now at 18, St. Augustine Parade, City Centre, Bristol, 1 (telephone, Bristol 20351; telegrams, "Noraluco, Bristol").